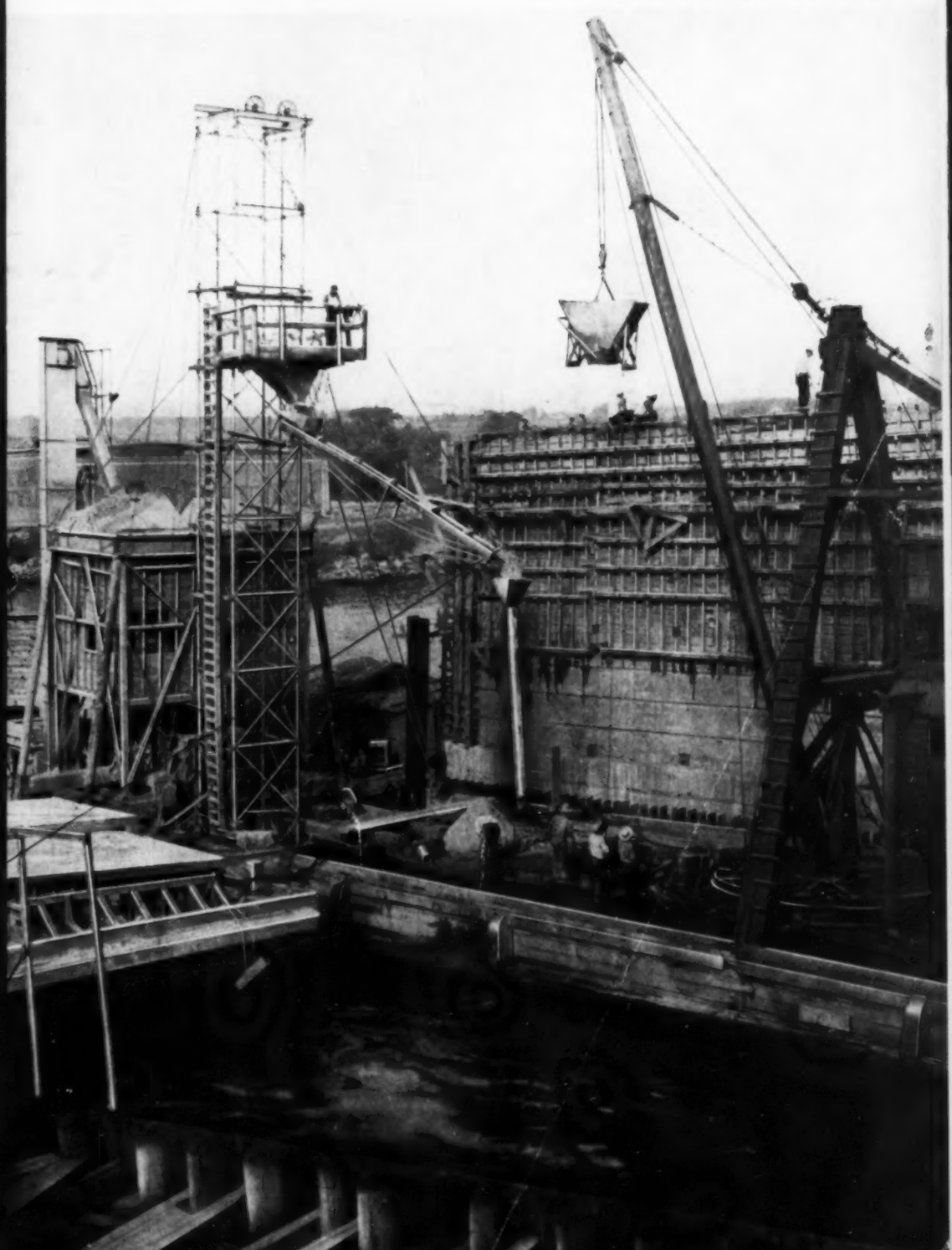
ruction
Methods

Floating Plant Places Concrete in Pier of Albany-Rensselaer Bridge Across Hudson River



Only a Decimal point . . .

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The world's largest cofferdam

Cofferdam and plant designed by Sloane Service for Allen N. Spooner & Sons on construction of Piers 88, 90, 92, North River, New York City.

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Consultation creates no obligation

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CONSTRUCTION METHODS, December, 1932. Vol. 14, No. 42. Published monthly. McGraw-Hill Publishing Company, Inc., 330 West 42d Street, New York, N. Y. $1 per year. Central and South American countries and Foreign, $2 U. S. Currency, or 10 Shillings. Canada (including Canadian duty), $1.50. 10 cents per copy. Entered as second-class matter, October, 1926 issue, Vol. 8, No. 19, at the Post Office at New York, N. Y., under the Act of March 3, 1879. Printed in U. S. A.

The Editor Notes—

Federal Funds for Relief Work

THE National Committee for Trade Recovery, sponsored by the Construction League of the United States, has performed a useful service by issuing a pamphlet which explains in detail how federal funds for construction purposes can be obtained from the Reconstruction Finance Corporation. The real solution for our unemployment and economic problems lies in initiating work of a kind that will furnish the greatest amount of useful employment and consume the most materials without adding to the present surplus of marketable goods. As a means toward this end, there should be a widespread acceptance and use of the federal government's offer to lend money to municipalities for financing the construction of public works' projects of a self-liquidating character, as provided for by the Relief Act.

The pamphlet is of particular interest to cities and towns that are in need of waterworks or sewerage improvements. Certain conditions must be fulfilled, however, to make projects of this type meet the "self-liquidating" requirement. The report goes into this subject in great detail, even supplying the text of model bills where state legislation is needed for the projects to qualify for R.F.C. loans.

Any community contemplating a public works' project for unemployment relief and in doubt as to the procedure to follow in applying for federal funds will do well to procure a copy of this report from the committee whose headquarters are at 330 West 42nd St., New York.

Preparing Bid Prices

Profit or loss on a construction contract begins with the prices that are estimated for the various items of work. Too often contractors display woeful ignorance or neglect of this important part of the construction business. Their tenders, prepared in a last minute rush and based on inadequate data, are sometimes nothing more than the wildest kind of speculation, resulting in severe losses. In a state letting early this year it is a matter of record that 40 per cent of the bids submitted contained errors, ranging from slight slips in arithmetic to failure to include unit prices or extend them into proper totals.

In the third of his series of articles on "Helps to Successful Contracting," Harry O. Locher, elsewhere in this issue, offers many helpful pointers on the preparation of bids. There is more to the matter of bidding than merely to determine prices which, under normal operating conditions, will yield a reasonable profit. Unless the contractor is in the fortunate position of having unlimited funds at his disposal, he should consider the unit prices for the various contract items with relation to the order of their performance. It is the part of wisdom to place a slight additional price on the items of work to be done first, in order to provide the necessary cash at the outset to insure adequate finances as the work proceeds. There is ample justification for this kind of reasonable unbalancing of a bid.

Another point relates to the subletting of portions of a job. Present-day conditions make it possible to "sub" work at prices that are extremely advantageous to the general contractor. However, the time to obtain these prices from subcontractors is before, not after, the contract is awarded.

NEXT MONTH

Annual Road Builders' Number

The year's outstanding developments in highway construction and maintenance will be featured in the January number of *Construction Methods*, appearing on the eve of the annual convention and equipment exhibit of the American Road Builders' Association.

CONSTRUCTION METHODS

A monthly review of modern construction practice and equipment

ROBERT K. TOMLIN, *Editor*

Editorial Staff

VINCENT B. SMITH NELLE FITZGERALD
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WILLARD CHEVALIER, *Publishing Director*

McGraw-Hill Publishing Company, Inc.
330 West 42d St., New York, N. Y.

River Diverted at Hoover Dam

AN important stage in the construction of the Hoover Dam was reached last month when the flow of the Colorado River was diverted around the dam site and through the 50-ft. diameter concrete-lined tunnels in the rock walls of the canyon. With this operation completed, during the present low stage of the river, Six Companies Inc., the contractor, will concentrate effort on building the permanent cofferdams across the river before the arrival of high water in the spring. If present plans materialize, the cofferdam construction will require about three months and the first concrete will be placed in the main body of the dam about June 1 of next year.

Preparations for handling the huge volume of concrete that will enter into the dam proper—3,400,000 cu.yd.—and the material excavated for the foundation of the structure, are already under way and involve the installation of five 20-ton cableways, two of them, with moving towers and spans of 2,580 ft. each, serving the spillway areas.

Latest reports from the Hoover Dam show a total of 4,213 men employed on the project.

A Congress of Opportunity

TOO FEW of our people understand the profound influence of our construction activities upon the economic health and prosperity of the nation. Almost everyone sees only their immediate aspects—they create taxes, cause temporary inconvenience or, at best, they provide new or improved facilities for doing something or going somewhere.

But the average business man does not see them as employing millions of men and women, using the products of innumerable mines, mills and factories, delivering thousands of carloadings to the railroads, absorbing millions of horse-power generated by the utilities.

He does not see their economic significance—that they convert our surplus earnings into billions of dollars of new consuming and buying power, so vitally necessary to the trade of Main Street. Only when construction work is curtailed, as now, is he aware of his devastating loss and conscious of its tremendous importance to him.

Thus the operations of the construction industry are of major concern to American business, probably second in importance only to agriculture. When construction prospers, there is prosperity for all; when it languishes the life-blood ebbs from the arteries of trade. It is impossible to imagine a prosperous America, under our present economic system, without a substantial and consistent construction program.

So the health of the construction industry is a matter of intimate concern to every American citizen; its problems are his problems, its strength is his prosperity.

Because of all this, unusual importance attaches to the forthcoming Highway and Building Congress, to be held in Detroit during the week of January sixteenth. For the first time in its history, all the elements of the construction industry will assemble to deal with its problems and to interpret its significance to the rest of the community.

More than twenty associations and groups of national scope and influence in the highway and building fields will hold their annual conventions in Detroit that week and will then unite in a two-day joint Congress. Thousands of public officials, engineers, architects, builders, contractors, equipment manufacturers and distributors, material producers and dealers will attend. Hundreds of manufacturers will exhibit during the week the materials, machinery and equipment they provide to help the architect, engineer and constructor meet the need of the times for more substantial structures and lower costs.

Here will be an unprecedented attack upon an unprecedented problem. It deserves the interest and support of all. Every one engaged in any department of construction will find at the Congress some measure of help and inspiration; every manufacturer whose products find a use in construction or highway maintenance will meet a huge and interested audience, probably the greatest ever assembled in one place by this far-flung industry.

And most important of all will be the opportunity offered by the Congress to interpret to the business man, the legislator and the general public the economic importance of the national highway program and of the building industry. For the first time the several elements of the construction industry will be assembled into a united group; for the first time they will speak through a common voice. Let us do our best to seize this opportunity for a united effort to conserve the welfare and foster the progress of the industry, both of so vital a concern to all of the people.

Willard Chevalier

Publishing Director

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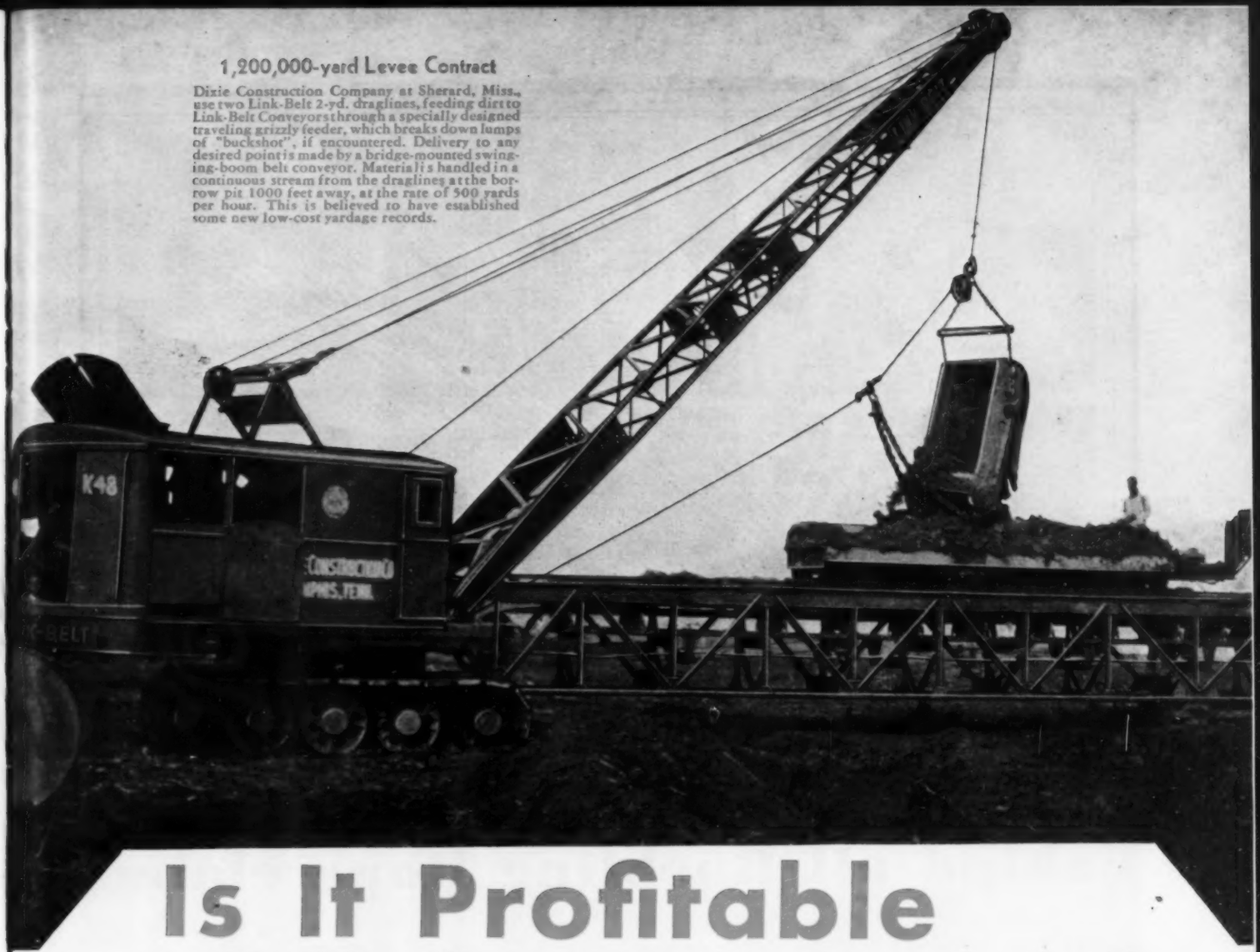

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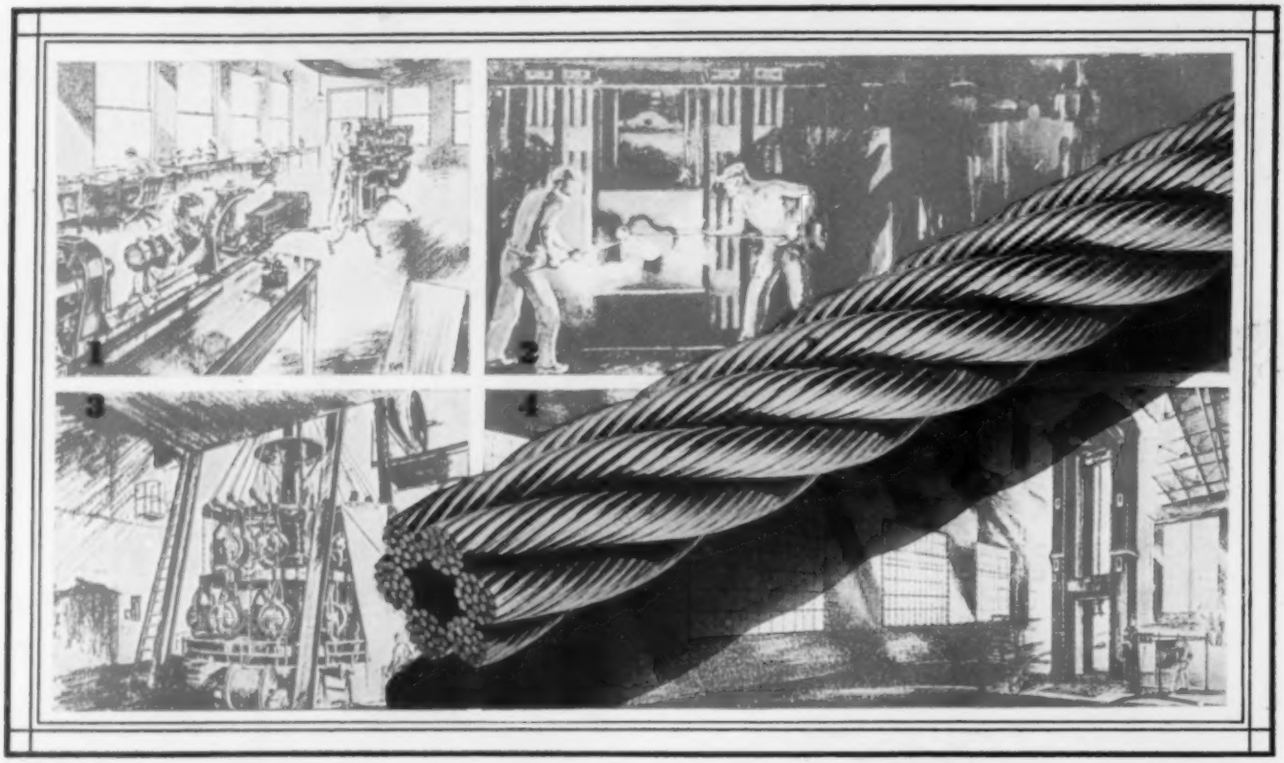

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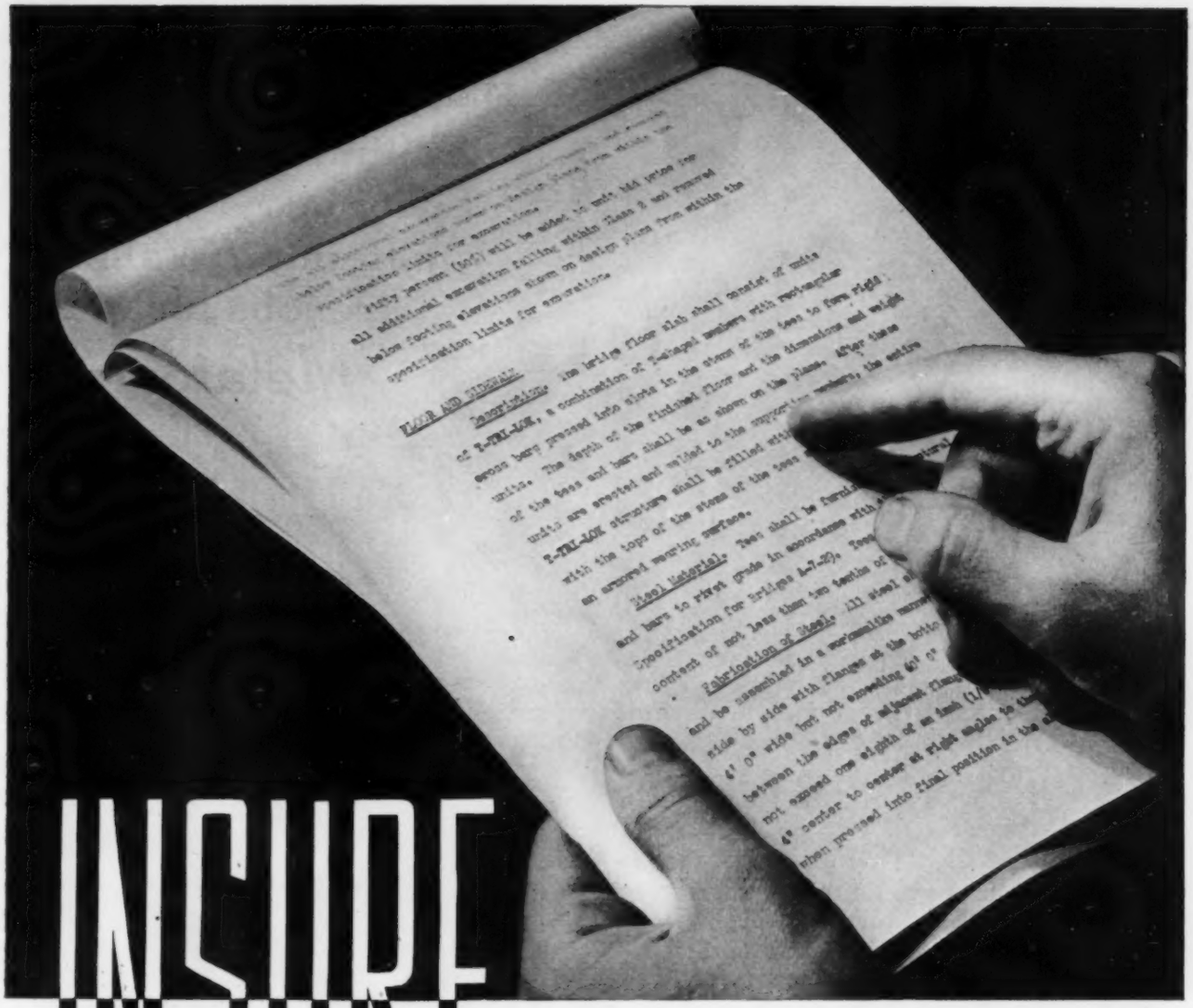

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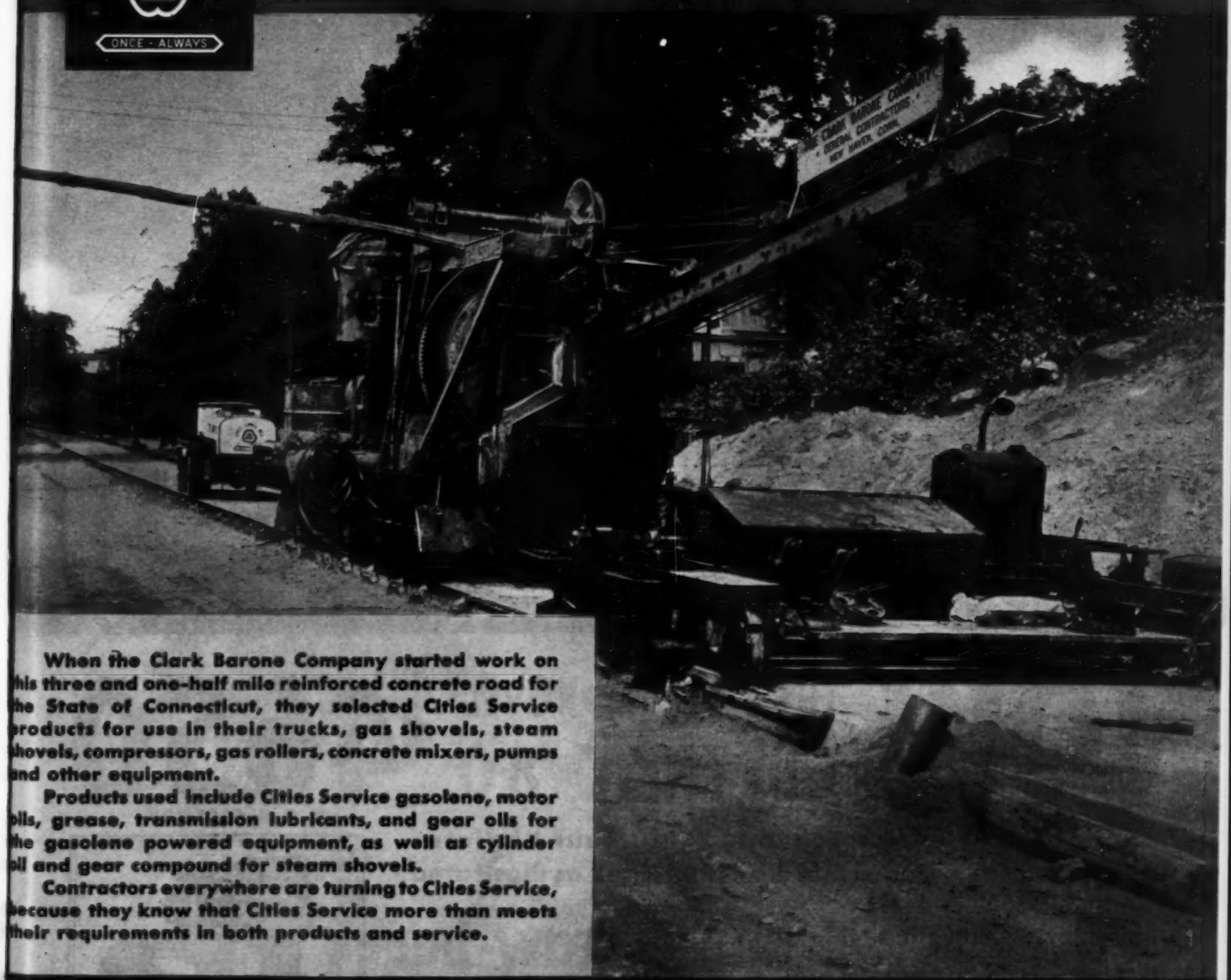

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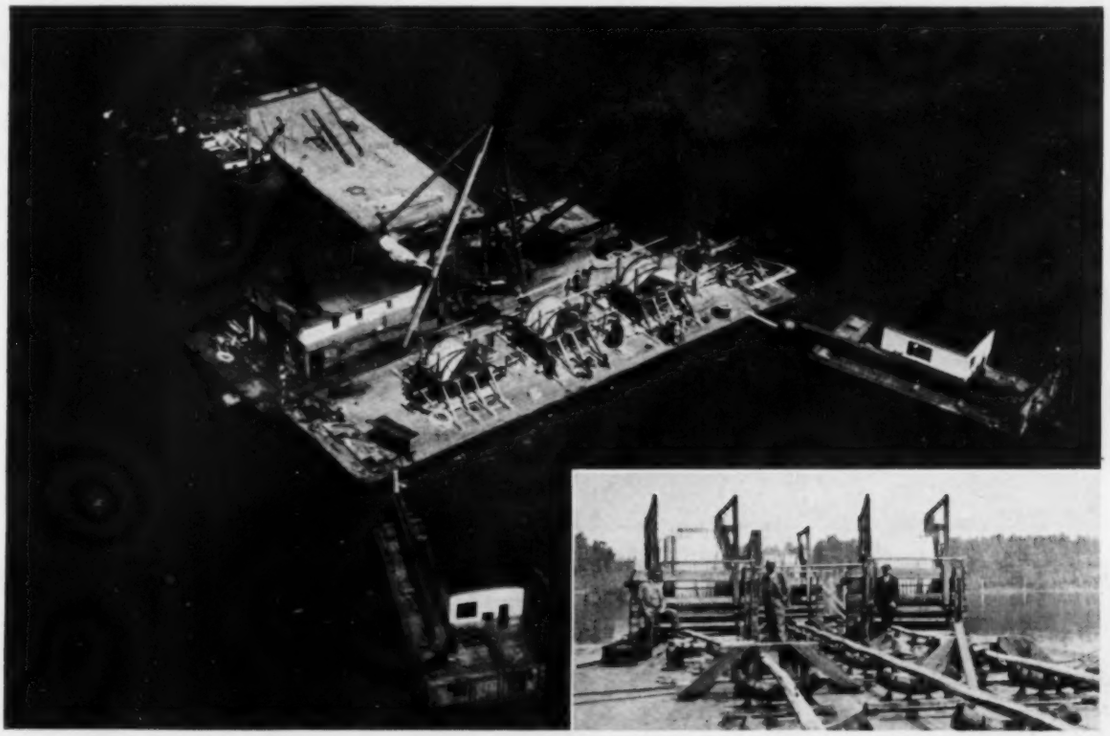
Construction Methods

ESTABLISHED 1919—McGRAW-HILL PUBLISHING COMPANY, INC.

ROBERT K. TOMLIN, *Editor*

VOLUME 14 NEW YORK, DECEMBER, 1932 NUMBER 12



THREE CABLE REELS mounted on barge unreel simultaneously as barge is moved ahead by steam derrick scow on downstream side. **EASY-RUNNING ROLLERS** *(in insert)* reduce friction in sliding cables astern.

Well Drilled Crew Lays OIL-FILLED SUBMARINE CABLES

THOROUGH training of construction forces in preparation for the first submarine installation of oil-filled cables in this country culminated in the successful laying of three 115-kv. single-conductor cables on the bed of the Columbia River near Portland, Ore., last summer, forming a link in the 36-mi. transmission circuit from the new Ariel plant of the Inland Power & Light Co. to the load center of the Northwestern Electric Co. in Portland. Because the Columbia River flow is divided at the point of installation by an island, two submarine crossings actually were involved, one 3,460 ft. long and the other 1,360 ft. in length. Low-water depth at the longer crossing is 28 ft., but high-water conditions with swift current prevailed during the cable laying.

Cable lengths exceeding the requirements for the two crossings were wound on individual reels in the bodies of which were mounted a sufficient number of cell-type pressure reservoir units to maintain an oil pressure between 5.1 lb. and 15.0 lb. during shipment and installation. The cable had an overall diameter of 3.8 in. and weighed 20 lb. per foot.

Cables for the shorter crossing were installed first, the three reels being mounted in tandem on a 400-ton flat-decked barge. After the shore ends had been pulled into the Oregon terminal and clamped, a steam derrick scow alongside the cable barge pulled the craft ahead by means of a hauling line, at the same time slacking off on a snubbing line at the stern. Two scows on the upstream side of the cable barge, each equipped with a gasoline donkey engine, held the main barge in position against the river current by maintaining tension in four 1,500-ft. steel cables attached to 5,000-lb. ship anchors. Anchor lines from the steam derrick scow steadied the equipment on the downstream side.

Anchors were moved ahead as the cable laying progressed in steps across the river. Each cable reel was equipped with two friction band brakes, one for laying and one for emergency. Similar methods were employed in installing the longer crossing. During the laying operations, oil supply to the cables was maintained through temporary connections from the permanent reservoir at the terminal. Cables for the submarine crossing were supplied by The General Electric Co.

Wide World Photo

ROUGE RIVER BRIDGE on Oregon Coast Highway has seven 230-ft. concrete arch spans, with 164 ft. of viaduct approach at each end, making total length of 1,938 ft. Concrete was chuted to place from 104-ft. tower on wheels traveling along 30-ft. gage track on falsework trestle. Contractors, Mercer-Fraser Co., Eureka, Calif.

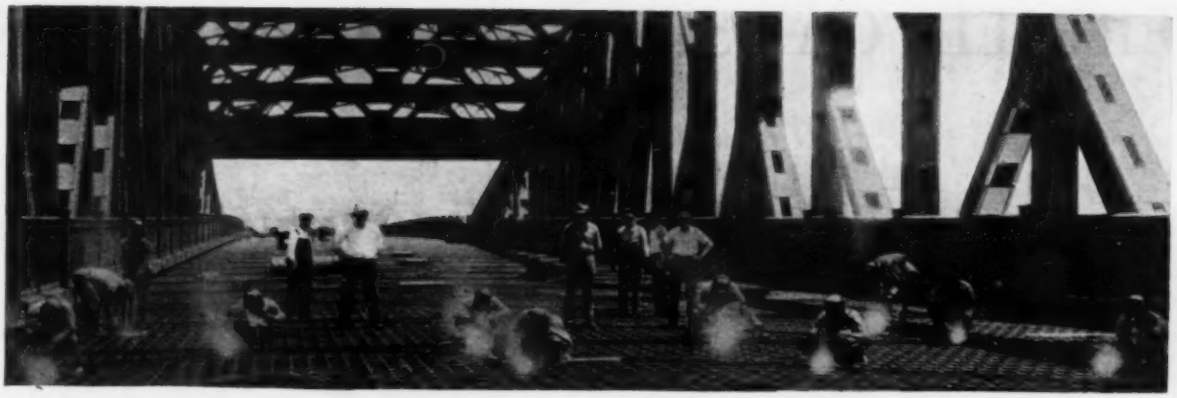
This Month's "News Reel"

Acme Photo

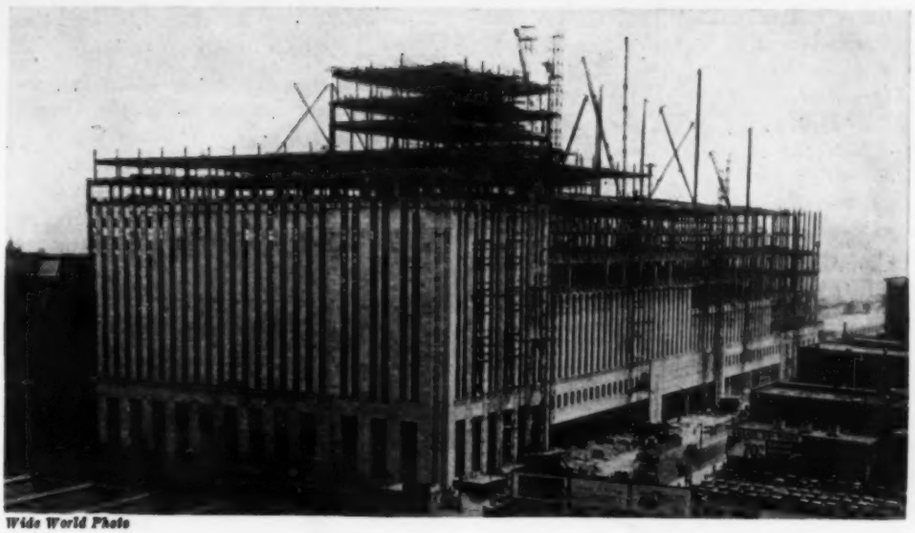
ELEVATED EXPRESS HIGHWAY along Hudson River front, New York City, speeds movement of north- and south-bound vehicular traffic. Section illustrated extends from 23rd to 59th Sts., joining previously completed section between 23rd and Canal Sts. Contractor, Poirier, McLane Corp.

Fairchild Aerial Surveys Photo

HUGE COFFERDAM, covering area 1,400x400 ft., has been built in Hudson River, New York City, to provide for construction of three 1,100-ft. steamship piers for Department of Docks. Structure of Lackawanna steel sheet piling has 10-ft. freeboard and depth, from top to rock, ranging from 54 to 97 ft.; it will be unwatered to depth of 50 ft. Spacing between sheet pile diaphragms is 50 ft. Cofferdam was designed for Allen N. Spooner & Son, Inc., contractors, by H. A. Sloane, Inc., engineers, New York.

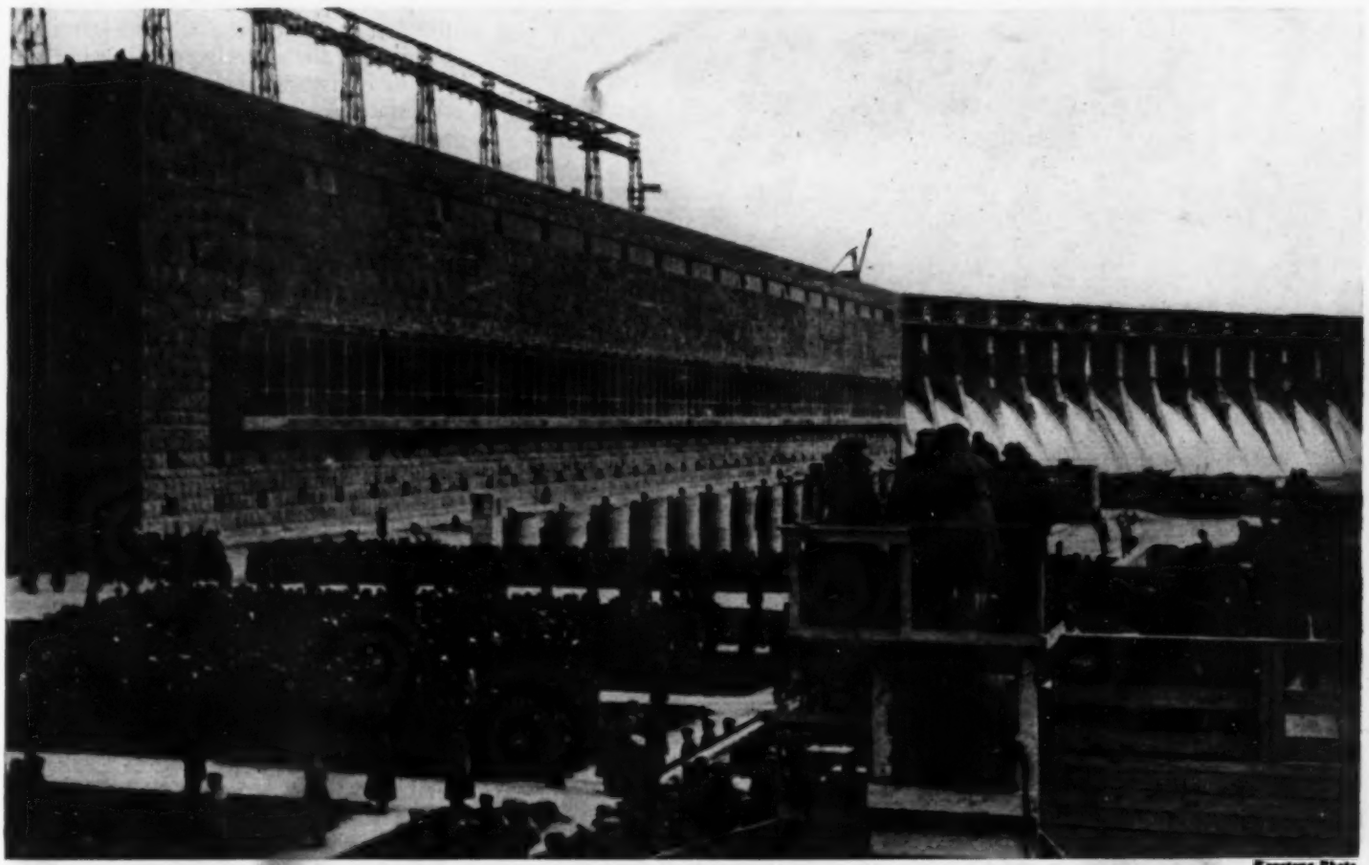


WELDED STEEL MATS of the bar truss type reinforce the 50-ft. wide concrete roadway deck of the 3-mi. long high-level viaduct just completed across the New Jersey meadows between Jersey City and Newark, for the State Highway Department. Roadway requires total of 925,000 sq.ft. of fabricated mat.



Wide World Photo

CHICAGO'S NEW POST OFFICE *(right)* is nearing completion over tracks of Union Station near city's Loop district. Main structure, covering area of 800x344 ft. is 9 stories high, with 12-story pylons at corners. Contractor, John Griffiths & Son Co.



Keystone Photo

RUSSIA'S LARGEST HYDRO-ELECTRIC PLANT on Dnieper River is dedicated by officials and engineers of Soviet Government. Project costing $110,000,000 will develop, ultimately, 750,000 hp. Col. Hugh L. Cooper, American engineer, served as consultant on the design and construction.

FERRIED CAISSONS AND PIPE PILES

form foundations of highway bridge and approaches

UNUSUAL methods of positioning the cutting edges of caissons for three river piers and the use of long closed-end pipe piles to carry extensive approach ramps distinguish the construction of the new Albany-Rensselaer (N. Y.) bridge across the Hudson River and of approach structures to eliminate grade crossings of the Delaware & Hudson R. R. in Albany, for all of which work the Booth & Flinn Co., of Pittsburgh, is general contractor. Operations at the bridge site are hampered by the presence of the railroad's main line, which intersects the Albany approaches, and by the necessity of maintaining extremely heavy traffic through both ends of the project and across the adjacent old bridge. The old bridge is so close to the one now under construction that the old swing span in open position extends completely under and beyond the new lift span in raised position.

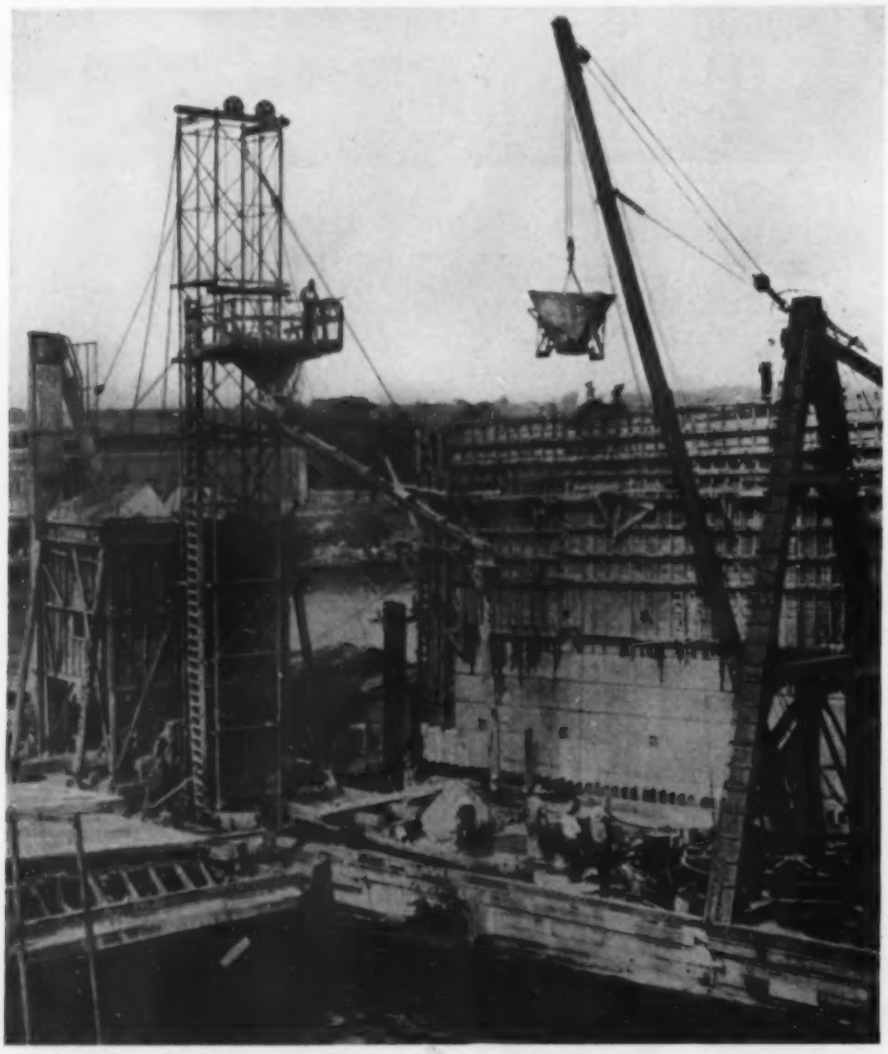
Development of Plan—This important improvement project had its origin in an endeavor to eliminate existing grade crossings of the Delaware & Hudson R. R. with the many streets in the vicinity of the old bridge in Albany. Different schemes to accomplish this end were proposed and studied. Finally, the general plan now under construction was evolved, with the exception that the old bridge was to be raised about 18 ft. to permit the elimination of grade crossings.

The dilapidated condition and inadequate facilities of the old bridge, combined with the impracticability of cutting off the heavy flow of highway traffic across the river during reconstruction, resulted in a decision on the part of the state that the elimination project ought not to be carried through without tying it up to a modern structure capable of taking care of the large amount of traffic involved. Final plans, therefore, provided for a new bridge to replace the old one, as well as for the elimination of all grade crossing in Albany. Replacement in any event would have been necessary in a few years.

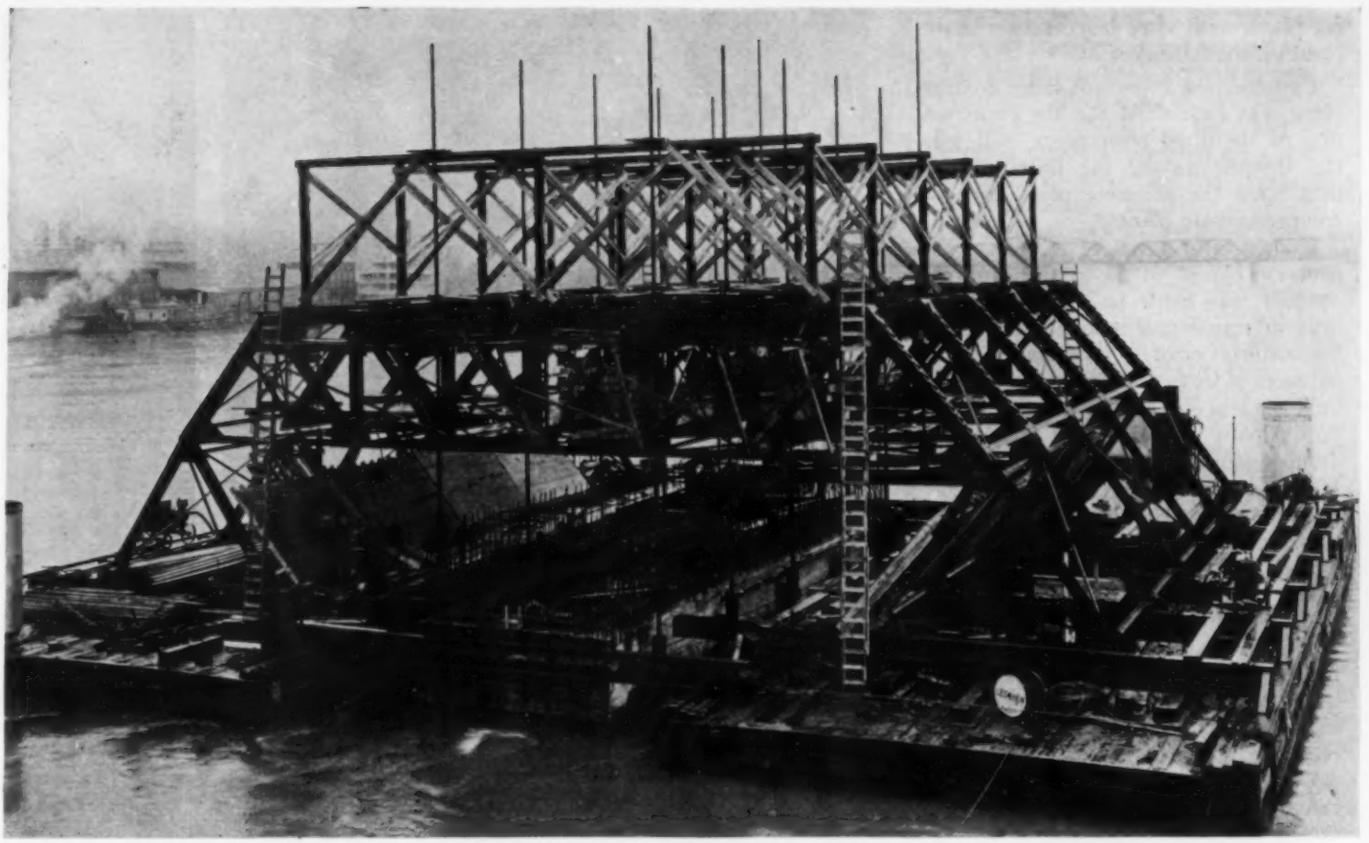
Grade crossing eliminations, embracing all ramp approaches on the Albany side, are being carried out in conjunction with the Delaware & Hudson R.R. Corp., which is required by law to bear 50 per cent of the cost. The cost of the remainder of the work, viz.: the bridge and the easterly approach in the city of Rensselaer, is being defrayed by the state, with a little financial assistance from Albany and Rensselaer Counties. Total cost of the entire improvement, including land and property damage, will be about $3,600,000.

Three Divisions of Project—Because of the extent and importance of the work upon the approaches, the project may rationally be subdivided into three distinct portions; the bridge proper, the Albany approaches, and the Rensselaer approaches. Of these three portions, the Albany approaches presented the greatest difficulty in carrying through a straight-forward construction program because of the complexity of the structures and the necessity of maintaining both highway and railway traffic through the construction area.

Work at the Albany end of the bridge involves the rerouting of the Delaware & Hudson main line and the construction of five approach ramps varying in length from 682 to 1,328 ft. and in width, curb to curb, from 24 to 44 ft. The ramps rest on steel-pipe pile foundations and consist of reinforced-concrete bents carrying spans of 22 to 45 ft. Most of the spans are of reinforced-concrete girder construc-



FLOATING PLANT mixes and places concrete in superstructure of river pier. When concreting pier substructure, vertical spout discharges directly into forms. For upper portion of pier, spout fills bottom-dump bucket which is handled into forms by derrick.



SUSPENDED CUTTING EDGE of caisson for river pier is built up and submerged in stages by adding concrete lifts and lowering with threaded rods until cutting edge rests on bottom. Threaded rods are supported by six parallel trusses resting on scow at each end

tion, with steel beams substituted for concrete girders in some places on the sharp curves of two of the ramps.

These two curved ramps connect with Broadway to the north. After relocating and building a temporary approach road to the old bridge from this direction, the contractor was able to construct these ramps and two others at right angles with them leading into east-and-west crosstown streets. Construction of the south Broadway ramp has to wait until the new bridge can take the traffic, as this ramp will obstruct the approach to the old bridge. Completion of the Albany approaches and of a 60-ft. double-track railroad bridge on the relocated and elevated main line in the same area will eliminate all grade crossings on Broadway and four cross streets and will give more favorable vehicular access to the docks of the Albany boat lines. Estimated contract cost of the work in Albany exceeds $1,000,000.

Included in the bridge proper are four steel truss spans, one of which is a lift span with a length of 341 ft. and clearances of 45 ft. in closed position and 135 ft. in raised position. Truss spans 222 ft. in length flank the lift span. The fourth steel truss span, at the Rensselaer end of the structure, is 167 ft. long between pier centers. Adjacent to this fourth truss span are two 40-ft. rolled-girder spans. A 42-ft. roadway provides for four lanes of traffic and two 6-ft. sidewalks take care of pedestrian needs.

Operations at the Rensselaer end of the project are less involved than in Albany. Two approach ramps diverge from the bridge at this end, one curving to the south to coincide with Broadway in Rensselaer (not to be confused with the street of the same name in Albany) and the second crossing Broadway on a 55-ft. rolled girder span flanked by two 30-ft. spans. The necessity of maintaining traffic over the old bridge delayed construction of the curved approach at this end of the project and added somewhat to the difficulty of the work. The contract cost of the bridge proper and of the Rensselaer approach is estimated to exceed $1,633,000, which, added to the $1,000,000 construction cost of the Albany approaches, makes the estimated aggregate expenditure for the entire project greater than $2,633,000, exclusive of right-of-way costs.

NORMAN McLEOD *(left)*, assistant superintendent, Booth & Flinn Co., and H. H. BROWN, senior assistant engineer, New York department of public works.

General Construction Program—In its general plan of construction procedure, the Booth & Flinn Co. adhered to the natural subdividing of the project into three parts. Operations in general were so planned and carried out that individual crews worked continuously on their own sections of the project for long periods of time, although numerous exceptions to this general procedure were made as need for transfer of crews or workmen occurred. In the same way, separate plant and construction equipment were provided for each division of the project, with the noteworthy exception that the Rensselaer side had no individual concrete plant, depending for its concrete upon a float-

ing plant, with some help from a shore plant on the Albany side.

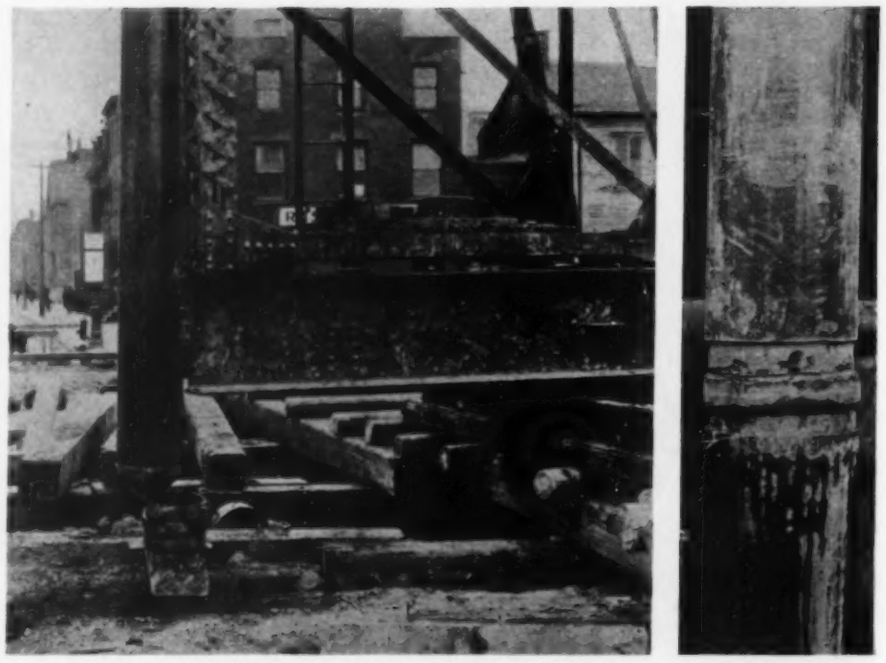
Construction Plant—A large floating plant was assembled for the construction of the three river piers. Of special interest among the units of this fleet were the concrete plant and the compressed-air plant.

Bulk cement was used at both of the concrete plants on the project, and no attempt was made to prevent loss of dust in transhipment and handling of the material prior to its delivery to the batchers. Covered trucks hauled the bulk cement for the floating plant to the Albany side of the river and dumped it into barges from a ramp. A Wiley steam whirley crane on the concrete boat transferred the cement by clamshell bucket from the barges to a hopper at the base of the concrete plant. From this hopper, a bucket chain elevator lifted the cement to the proper compartment in the Blaw-Knox 115-ton steel bins. Cement was a contract item and was paid for by the state in accordance with the weight recorded at the batching plant.

Cement and aggregate at the floating plant were weighed by Blaw-Knox batching equipment which delivered to a charging hopper that discharged into the drum of a 1-yd. Lakewood mixer. Concrete was elevated by a 1-yd. bucket in a 50-ft. tubular tower of the floating plant. The tower bucket discharged through a short chute and vertical spout either into the substructure forms or into a 2-yd. Blaw-Knox bottom-dump bucket for elevation to the superstructure.

Specifications permitted local sand and gravel to be used exclusively for substructure concrete but required that crushed limestone be employed as coarse aggregate and a 50-50 mixture of local sand and coarse seashore sand as fine aggregate in superstructure concrete. Crushed limestone and local sand and gravel were delivered to barges by dump trucks in the same way as the bulk cement. The seashore sand was shipped in by barge. All aggregates were handled into the bins of the floating plant by the steam whirley crane.

Electric motors drove the four compressors of the floating air plant, a 5,000-v. line being run from the shore to the transformers on the boat. To take care of emergencies caused by any failure of the power supply, the plant was equipped with diesel engines capable of running two compressors. The compressor units included a Sullivan 500-cu.ft. machine which maintained a pressure of 110 lb. for operating the drills and other pneumatic tools, and three low-pres-



CLOSED-END STEEL-PIPE PILES up to 86 ft. long are driven to rock to carry five approach ramps in Albany. Steel driving point of pile at left is resting on edge of inside sleeve used in splicing 40-ft. pipe lengths, as shown at right.

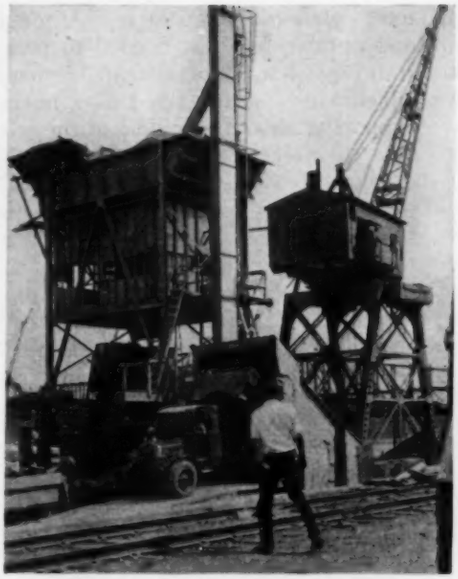
INSTALLING REINFORCEMENT for base slab on bridge approach. Granite curb in background has been set to line and grade prior to placing of concrete In foreground is guide for screeding surface of base concrete.

TIMBER FALSEWORK in place for erection of 222-ft. truss span flanking lift span. Steam whirley crane on concrete barge in background handles bulk cement and aggregates by clamshell bucket into bins of mixing plant.

sure machines. Of the latter units, two were Ingersoll-Rand compressors, one with a capacity of 700 cu.ft. and the other of 1,200 cu.ft., and the third was a Chicago Pneumatic machine capable of delivering 1,000 cu.ft. per minute. One of the Ingersoll-Rand compressors was convertible to high pressure but was operated only at low pressure. Caisson pressures required at the three river piers never exceeded 21 lb., and the sand hogs never worked in the caissons at pressures greater than 18 lb. per square inch.

To handle forms and concrete at the river piers, the contractor bought a derrick boat equipped with a wood stiff-leg derrick having a 60-ft. boom. Two tugs, one steam-powered and the other equipped with a gasoline motor, moved floating equipment and materials on the water. The barge fleet consisted of 12 units from 70 to 135 ft. long.

Land Plant — Practically all the 22,800 yd. of concrete involved in the bridge proper and in the Rensselaer approaches, exclusive of the pavement base and wearing surface, has been supplied by the floating plant. An even larger volume of concrete amounting to 34,620 yd., exclusive of the 9,400 yd. required for pavement foundation and top course, is being produced by the mixing plant on the Albany side of the river. In general, this plant was equipped similarly to the floating plant, with certain minor exceptions. The Blaw-Knox steel bins have a capacity of 150 tons, the steam whirley crane is mounted on a stationary gantry tower and the mixer is a 1-yd. Ransome.

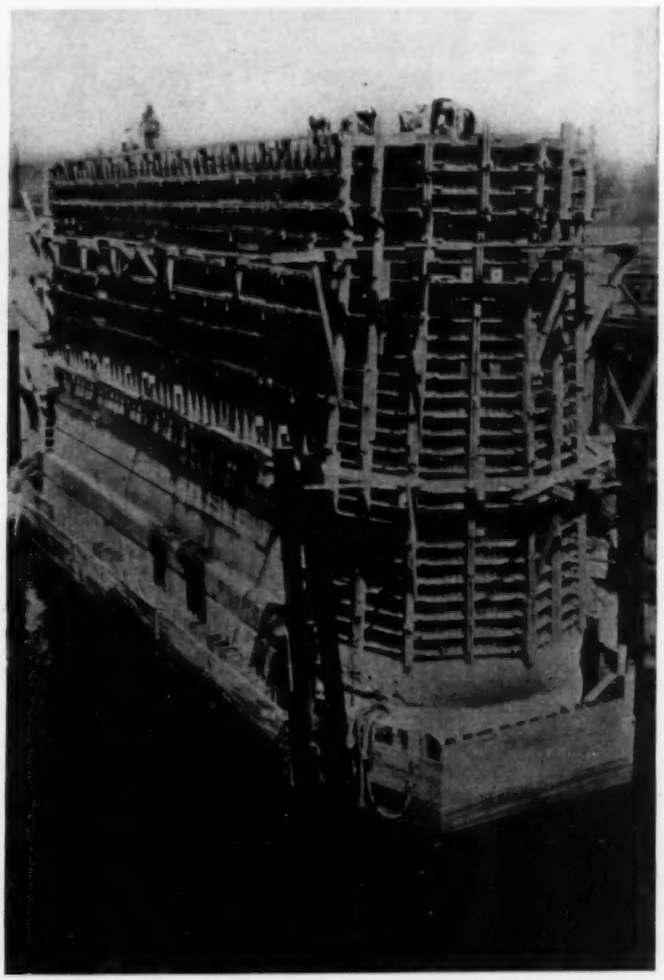


BULK CEMENT is delivered to shore plant on Albany side by covered end-dump truck. Whirley crane on stationary gantry tower feeds aggregate bins.

Concrete was distributed from the land mixing plant by ten Ford dump trucks which discharged loads directly into foundations or into 2-yd. Blaw-Knox bottom-dump buckets for transfer into superstructure forms. Stiff-leg derricks or cranes handled concrete buckets, forms, and reinforcing steel for the various structures. A steel stiff-leg derrick handled excavating and concreting operations at the west, or Albany, abutment, and a wood stiff-leg derrick performed similar functions for the east abutment and the two adjacent piers. For foundation excavation and grading the contractor used six machines, four P&H, one Osgood, and one Michigan, ranging in capacity from $\frac{3}{4}$ yd. to $1\frac{1}{4}$ yd. Some of these machines operated as shovels and others as cranes.

Pier Caissons—To place in position and build the caissons of the three river

HYDRAULIC-FILL MATERIAL under Rensselaer approach ramps is distributed by Allis-Chalmers tractor equipped with bulldozer. First truss span, 167 ft. long, has been erected.



WOOD PANEL FORMS are used six times on three river piers. Pier superstructure is carried up in two lifts. On this pier one of towers for lift span will be erected.

piers, the contractor employed a novel method which proved both effective and economical. The cutting edge of each of the three caissons was laid on a pile-supported platform constructed for this purpose in the river. After the first lift of concrete had been carried up from the cutting edge, a set of six steel trusses spanning between, and supported by, two scows were floated over the wharf, and the bottom lift of the caisson was picked up by threaded rods suspended from the trusses.

Tugs towed the suspended caisson clear of the wharf, and workmen lowered the cutting edge a few feet into the water to obtain partial flotation of the load. The caisson then was towed to its exact position in the river, and the scows were securely anchored by lines in four directions. In this position concrete was added lift by lift and the caisson was lowered by the threaded rods to keep a fairly uniform load on the trusses until the cutting edge had settled into the bottom of the river. When the caisson had been sunk to this point, shafts and air locks were installed, and the caisson was sunk by customary methods under air pressure to rock bottom of Hudson River shale.

total depth of 70 to 90 ft. A tough and durable pile was needed to penetrate the 4-ft. thickness of hardpan, which after driving acted as a lateral support at about the middle of the pile. The engineers specified closed-end 14-in. diameter steel-pipe piles with a wall thickness of $\frac{3}{8}$ in., and the contractor selected seamless tubing of the National Tube Co. to stand up under the hard driving.

A total of 63,000 lin.ft. of closed-end steel-pipe piles was driven and filled with concrete for the Albany approaches. The length of these piles

stalled 13,200 lin. ft. of reinforced-concrete piles and 1,815 lin.ft. of 10-in. steel-pipe piles.

Falsework and Forms — Timber falsework was used exclusively for reinforced-concrete work, with the exception that steel stringers occasionally were employed for the longer spans. Forms were made of wood and all exposed surfaces were lined with Masonite Presdwood. A single set of panel forms was used twice on the superstructure of each of the three river piers, or six times in all.

Progress Schedule — The lift span

BRIDGE APPROACH in Rensselaer crosses Broadway on 55-ft. rolled-girder span flanked by two 30-ft. spans. Another approach ramp will swing to right on down grade to connect with Broadway.

REINFORCED-CONCRETE BENTS on pipe-pile foundations support approach ramps in Albany. Five ramps of similar construction form approaches to this end of bridge.

A step-by-step pictorial story in an early issue will illustrate and describe this method completely.

Cofferdams — A steel sheetpile-cofferdam was used in excavating for the west abutment, on the Albany side of the river. A wood plank cofferdam sufficed at the pier nearest the river on the Rensselaer side.

Pipe-Pile Foundations — A special geological condition on the Albany side of the river made steel-pipe column piles necessary and desirable for the foundations of the approaches on this portion of the work. The approach area is covered with filled ground and with sand and gravel to a depth of 30 or 40 ft., where a hardpan stratum about 4 ft. thick occurs. Below the hardpan is another layer of sand and gravel extending to shale bedrock at a

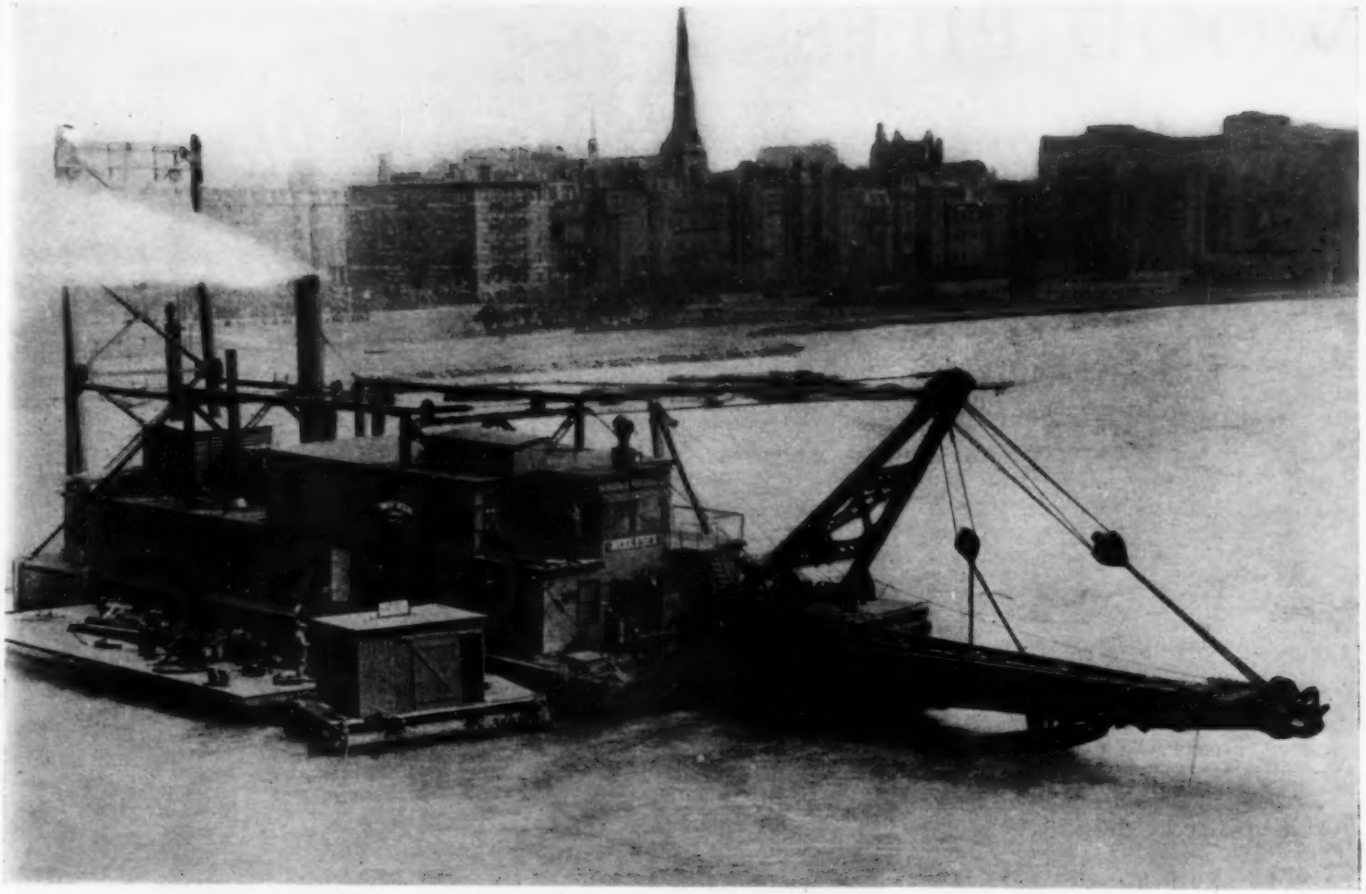
averaged 70 ft.; up to the end of July, the maximum length was 86 ft. The pipe was received in 40-ft. lengths which were spliced in driving by means of an inside sleeve. The sleeve had a circumferential ridge that fitted between the pipe ends, as illustrated by one of the accompanying photographs. Another photograph shows the method of installing the steel driving point at the lower end of the first section of a pipe pile.

In addition to the steel-pipe piles, about 29,000 lin. ft. of tapered Raymond cast-in-place concrete piles up to 35 ft.. long was driven for the Albany approaches. The Raymond Concrete Pile Co., contractor for this work, also drove the steel pipe piles with its standard pile-driving rig. On the Rensselaer side of the river, the contractor in-

was erected in raised position during the fall, thus making sure that the river would be open to navigation at all times. As soon as the steel erection and the paving of the new bridge have been completed, demolition of the old bridge will be started. This demolition will be completed during the winter, and in the spring of 1933 the south approach ramp on the Albany side will be constructed.

Administration — Design and construction of the Albany - Rensselaer bridge are under the direction of the New York department of public works, Frederick Stuart Greene, superintendent, and Thomas F. Farrell, chief engineer. H. O. Schermerhorn, assistant chief engineer, is responsible for the design and construction. Oscar Hasbrouck exercises general supervision over field operations on this bridge project and on several others. H. H. Brown, senior assistant engineer, is in direct charge of field operations. Waddell & Hardesty, of New York City, acted as consultants on the design of the steel superstructure.

Grade elimination work in Albany is under joint supervision of the state and the Delaware & Hudson R.R., James M. MacMartin, chief engineer. Under A. Rex Flinn, president, and George Hockensmith, vice-president, operations are directed for the Booth & Flinn Co. by N. H. McLain, superintendent, and Normal McLeod, assistant superintendent. C. D. Whitcomb is contractor's engineer on the job.



HYDRAULIC DREDGE engaged in deepening Charles River, Boston, takes power from outside sources to drive electric motors operating dredge pump and cutter head. Oil-burning boiler heats dredge and supplies steam to engine which operates swinging and ladder-hoist motions.

Outside Power Drives Electric Motors of REVAMPED SUCTION DREDGE

WIDE DISTRIBUTION of electric power in the areas where its suction dredge, "Middlesex," would be used induced the Trimount Dredging Co., of Boston, to take advantage of potential savings in operating costs by installing electric motors to drive the cutter head and pump. Originally built for complete steam operation, the "Middlesex" still retains one oil-fired boiler for heating purposes and for supplying a double horizontal reciprocating steam engine which drives the winding machinery.

Both cutter head and dredge pump, however, are now operated by electric motors using outside current. The dredge pump has a 17-in. suction and a 15-in. discharge and requires a 500-hp. variable-speed motor of 500 r.p.m. maximum speed. For the cutter head, which runs at a maximum speed of 25 r.p.m., a 300-hp. variable-speed motor of 1,750 r.p.m. maximum speed is used, necessitating speed reducers between the motor shaft and the main shaft upon which the cutter head is mounted.

Speed reduction is made in two steps, the first being accomplished by a De Laval worm gear of 13¼ to 1 ratio and the second by a spur gear reduction. The speed reducing mechanism and the cutter-head motor are mounted on the dredge ladder. As the ladder is operated at various angles, from the horizontal to an inclination of 45 deg., a forced-feed lubricating system is employed for the worm-gear unit. This lubricating system consists of a gear pump at one end of the worm shaft, connected to draw oil from the bottom of the case and deliver it to each of the plain sleeve bearings of the worm gear shafts and to the worm and gear tooth surfaces, as well as to a Kingsbury bearing which takes the thrust of the worm. The gear shaft carries a pinion which engages with a cast-steel, cut-tooth, spur gear enclosed in a water-tight casing and running in oil.

A bedplate of welded construction supporting the motor, the worm drive and the bearing stands, both fore and aft of the spur gears, is riveted and welded to the side girders of the ladder. The ladder, with the cutter machinery, measures 60 ft. 8 in. from the hinge pin to the end of the cutter. It replaces one of much lighter construction and is partly supported when in the water by a pontoon tank measuring 17½x14 ft. by 6 ft. deep, which is secured to the under side of the ladder hinges and stands with its top approximately at water level when the cutter machinery is in horizontal position. The joint between the ladder suction pipe and the hull pipe is a water-serviced swivel elbow. The hull of wood, measures 106x35½ ft. by 10 ft. deep. All dredging equipment of the "Middlesex," including the dredge pump assembly, winding machinery, A-frame, sheaves and cutter machinery, was designed and built by the Norbom Engineering Co., Darby, Pa.

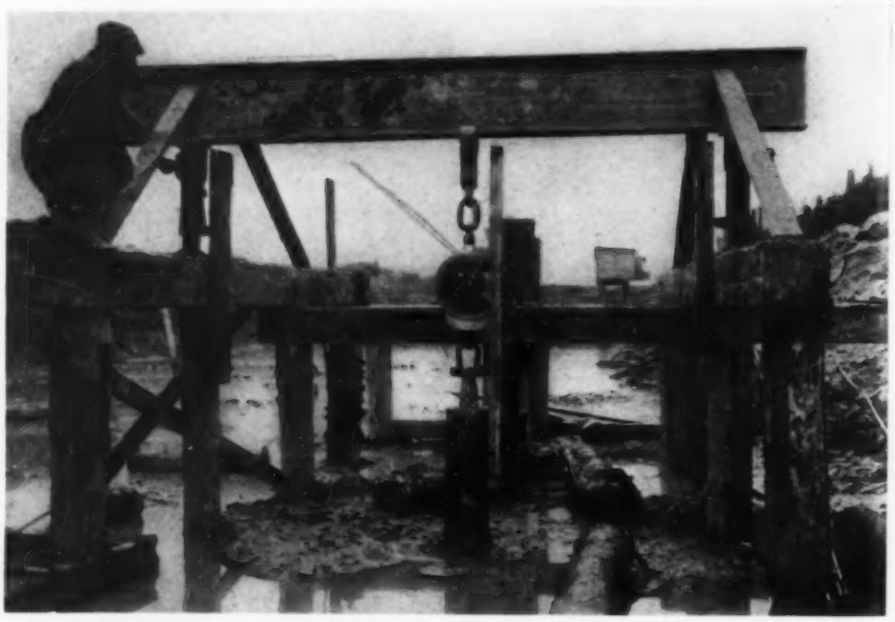
WOOD PILES

Anchor Sewage Treatment Plant Constructed Below Lake Level

SURROUNDED on three sides by Lake Erie, the location of a new activated sludge plant, known as the Easterly sewage disposal plant, being built by the City of Cleveland, led to some unique design and construction features. Contracts now being executed cover construction of aeration tanks, operating gallery, sludge settling tanks, return sludge pump building with settled-sewage conduit and outfall, and a new breakwater.

With the exception of the new breakwater, all this construction is being carried on over an area, enclosed by an existing breakwater, excavated to approximately 13 ft. below the present water level of Lake Erie. Present construction is enclosed by a steel cofferdam made up of 16-in. Lackawanna and Inland arch-web steel piling, weighing 25 lb. to the square foot and 28 ft. long. There are approximately 2,500 lin. ft. in this cofferdam wall, and inside the cofferdam about 475,000 cu.yd. of extremely stiff clay is being excavated. The new breakwater is being constructed about 700 ft. north of the existing breakwater and between these two breakwaters the material excavated from the disposal plant site is being dumped.

Pile Tests — Because the disposal plant is being built below lake level, the floor had to be designed and constructed to resist vertical hydrostatic pressure. Core borings showed a 25-ft. stratum of clay with quicksand pockets, weighing 140 lb. to the cubic foot. Extensive pile-pulling tests were, therefore, necessary to determine the frictional resistance each pile exerted against normal upward hydrostatic thrust. In making such tests two pile clusters approximately 10 ft. apart were driven to refusal. Cribbing of 12x12-in. timbers was placed upon these pile clusters. A 25-ton jack then was placed on each crib and upon the jack two 12x12-in. timbers were set. The pile to be pulled had been driven midway between the pile clusters. A dynamometer was suspended from the center of the transverse timbers and fastened to the pile which was to be pulled. As the transverse timbers were jacked up, direct readings were taken on the dynamometer.

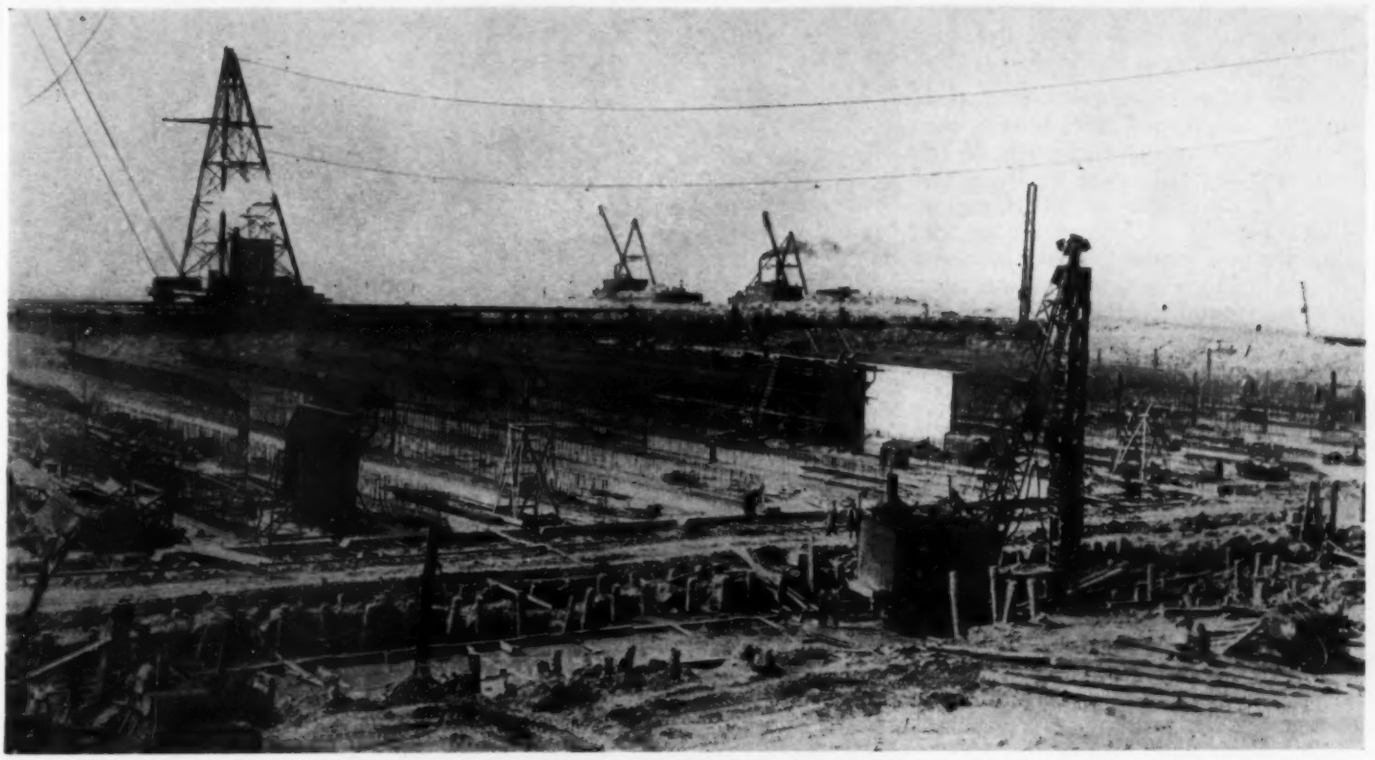


DYNAMOMETER suspended from transverse beam and attached to wood pile measures resistance of pile to pulling as beam is jacked upward at each end. Timber transverse beams ordinarily are used for this test.

COFFERDAM of arch-web steel-sheet piles is anchored by turn-buckle tierods to timber-pile clusters.

These tests showed that each pile would develop about 900 lb. resistance to upward thrust for each square foot of frictional surface. With the piles averaging more than 20 ft. in length a maximum uplift tendency of 12 tons per pile was overcome with a reasonable factor of safety. To resist this upward thrust, therefore, timber piling was driven on approximately 5-ft. centers over the entire area, 606,000 ft. of piling being used.

The piles and the floor slab are tied



TRAVELING TOWER CABLEWAY serves construction area of 22 acres, handling concrete, steel forms and reinforcement.

together in the following manner: Two 3-in. angles are first bolted vertically to the sides of the pile. To the tops of these angles are bolted two horizontal, backed-up 3-in. angles set parallel with the top of the finished floor slab. All piles are then capped with a 24-in. cap of concrete, the concrete extending down 6 in. below the ends of the vertical angles, which are 30 in. long. The 18-in. floor slab extends 6 in. above the top faces of the horizontal angles. Bar reinforcing placed at the level of the undersides of the horizontal angles serves to tie the entire construction into a rigid unit.

Rich concrete has been specified to make the entire concrete structure as waterproof as possible. Seven sacks of cement to each yard of concrete is used throughout the job. Such a rich mix obviously serves all structural requirements, tests showing that an average strength of 3,300 lb. is obtained at 7 days and approximately 6,000 lb. at 28 days. Coarse aggregate is stone, graded down from 1½-in. diameter. With 7 sacks of cement for each cubic yard of concrete, the mix is 1 : 1.6 : 3.2.

Concreting — Sand and stone are batched in one of the yards of the Cleveland Builders Supply Co. and are then trucked to a central concrete plant on the job. Cement is handled in bulk from riverside silo storage in downtown Cleveland to the job in White trucks with special rectangular tank bodies containing two elliptical openings in the top of each tank and an end dump gate. All concrete is mixed at the central plant. Bulk cement is dumped direct from tank trucks into the boot of an elevator which carries the cement into cross-connected overhead tanks equipped with weighing hoppers. The sand and stone batches are handled in practically the same manner.

From the overhead storage concrete materials are diverted into one of two Smith mixers—a 2-yd. electric or a 1-yd. gas-driven machine. From either or both of these mixers the concrete is dumped by gravity into a loading hopper and then into circular 4½-yd. bottom-dump buckets resting on flat cars. A gas-driven Plymouth industrial locomotive, the trucks of which have been adapted to standard-gage track, operates over a track for a distance of approximately 500 ft. from the mixing plant and parallel to a cableway crane

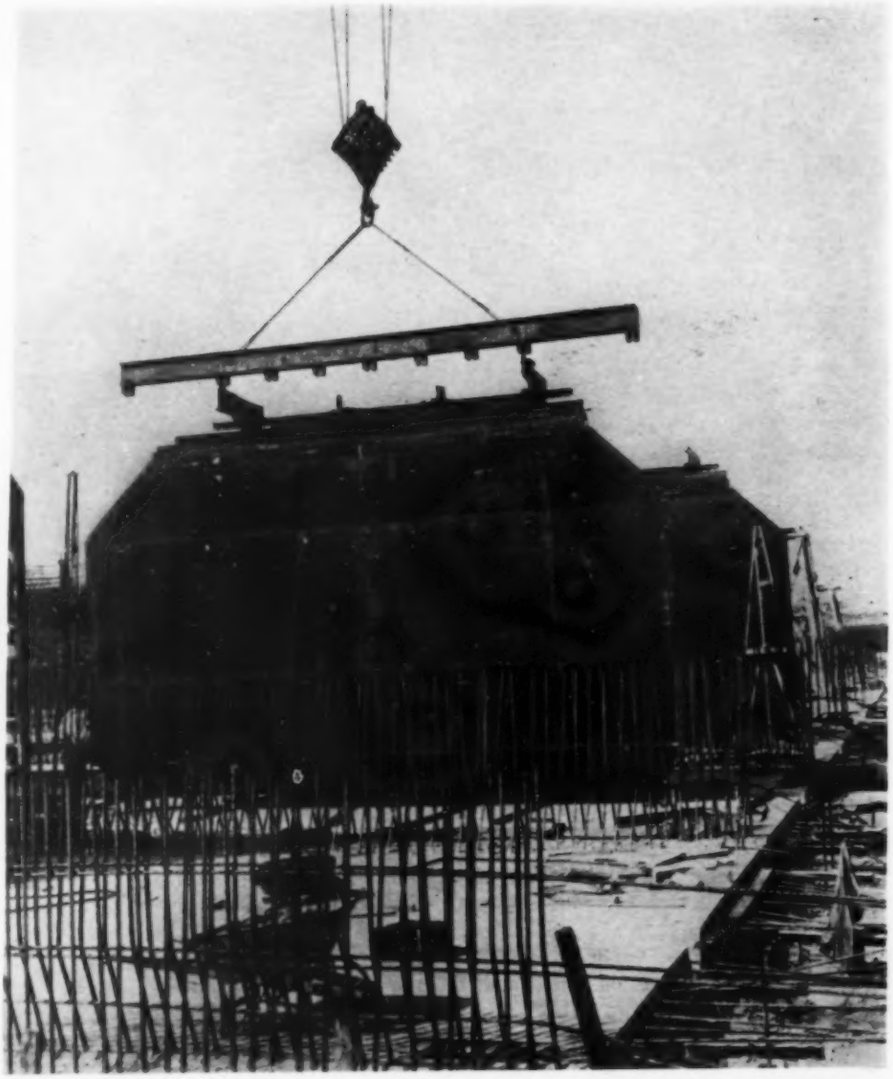
ANCHORS which tie floor slab to wood piles consist of two vertical steel angles bolted to each pile with two horizontal angles bolted to top of vertical angles. Concrete caps on piles inclose lower portion of vertical angles. Floor slab 18 in. thick will extend 6 in. above horizontal angles.

rail. This cableway then handles the concrete in the bottom-dump buckets to the site where it is deposited.

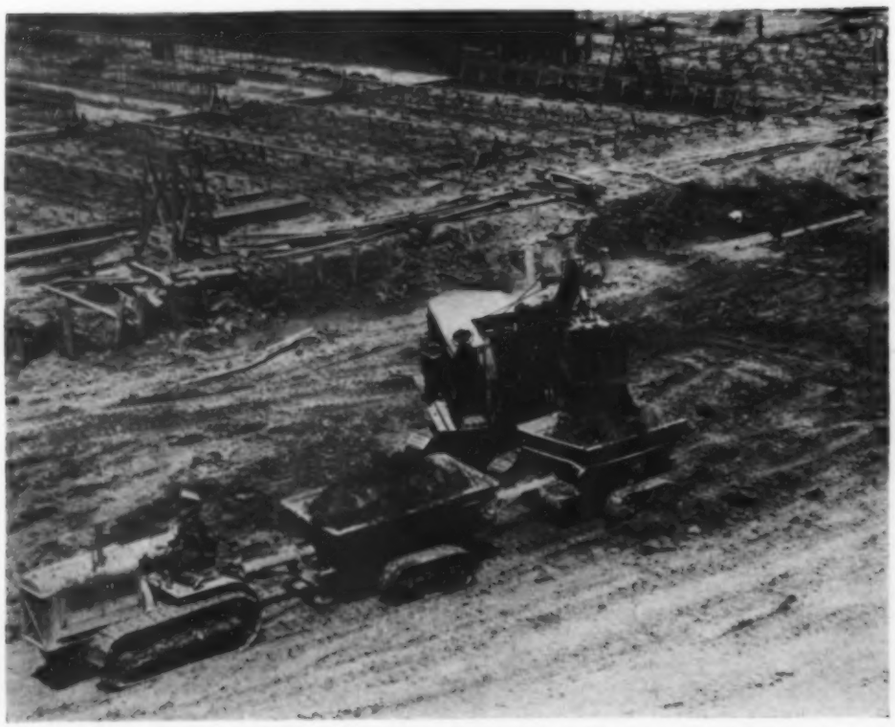
Cableway—The cableway is carried by two Lidgerwood steel towers, the head tower being approximately 85 ft. high and the tail tower 65 ft. This cableway has a span of 750 ft. and a lifting capacity of 15 tons. Through an electrical signal system between towers and by a line of drop cords suspended from the cableway materials and equipment can quickly be spotted at any desired location. The gantries themselves have a travel of about 1,200 ft., the entire construction area of 22 acres being served by this system.

Forms—An interesting feature in connection with the concreting is found in the design of the formwork for the aeration tank walls, which have a top section in the shape of a wye. To meet this construction Koppel steel forms were specially designed with hinged panels so that they could be used interchangeably on interior walls of wye section and on exterior perpendicular walls. With three such sets of forms the aeration tank walls can be concreted in 116 different setups. One set of steel circular forms will suffice for the sludge tanks. In all other concrete work wood forms are used and where a surface finish is required forms are faced with plywood to obviate the need for extensive manual finishing.

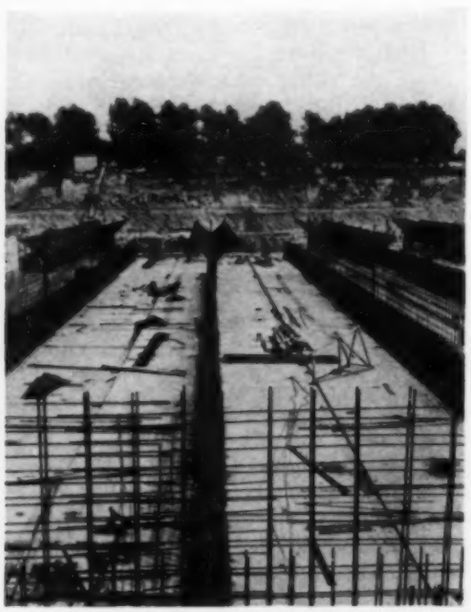
In excavating the site the easterly half was completely excavated first, so that construction could proceed with



SPECIAL STEEL FORMS for aeration tank walls are handled by tower cableway.



STICKY CLAY in disposal plant area is excavated by power shovel and loaded into two 4-yd. Euclid wagons drawn by 60-hp. tractor.



AERATION-TANK WALLS have wye shape at top, as indicated by steel reinforcement in place.

STEEL HEAD TOWER of movable cableway travels on five rails and is 85 ft. high.

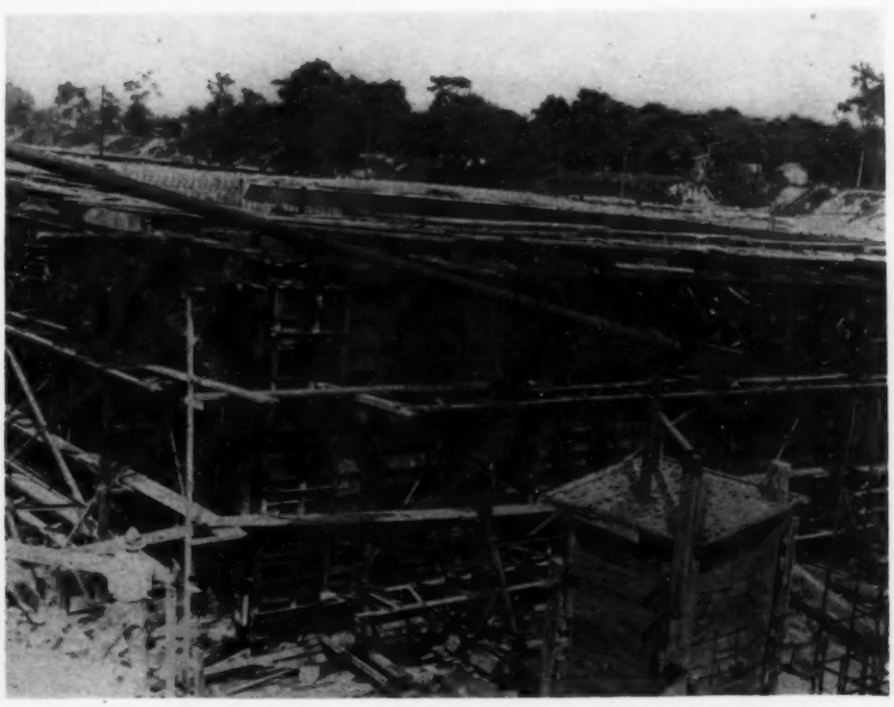
the least delay. Both shovels and draglines were used. Excavated material was hauled to the spoil bank in 4-yd. crawler dump-wagons hauled by Caterpillar "60" tractors.

Breakwater — Approximately 4,500 lin. ft. of breakwater will enclose the entire site. This breakwater is being built with a top width of 10 ft., a $1\frac{1}{2}:1$ slope on the lake side and a 1 : 1 slope on the shore side. The average height of this wall is 24 ft., of which 9 ft. projects above the present level of Lake Erie.

Particular care was exercised in anchoring the cofferdam. Timber piles 35 ft. long were driven at a 30-deg. angle on the inside of the cofferdam, and on $5\frac{1}{3}$-ft. centers. Eight-inch angles bolted to the sheet piling 6 ft. from the top of the sheet piles form a continuous wale. The battered wood piles are fastened to the sheet piling and the wale by horizontal and vertical 1-in. bolts. The strength of this construction has been demonstrated by the fact that the tail tower, running on a track immediately back of the cofferdam, has not caused the slightest movement either in the batter piles or the cofferdam.

Personnel—The work is being done for the city of Cleveland by the American Construction Company. George B. Gascoigne is the consulting enginetr. R. S. Jones is resident engineer for the consultants and W. A. Cunningham resident engineer for the city of Cleveland. Carl Ashley is in charge of construction for the contractor.

4¼-YD. BOTTOM DUMP BUCKETS are filled with concrete at mixing plant and are transported to cableway by railway.



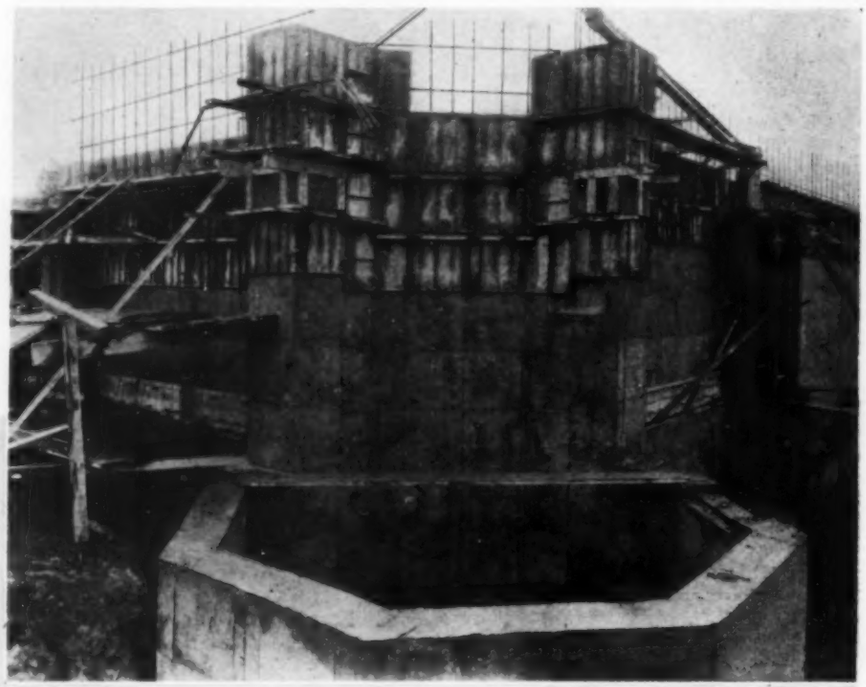
HINGED PANELS on special steel forms make them equally useful for perpendicular outside walls and for wye-section aeration-tank walls. Entire job requires 116 set-ups of steel forms.

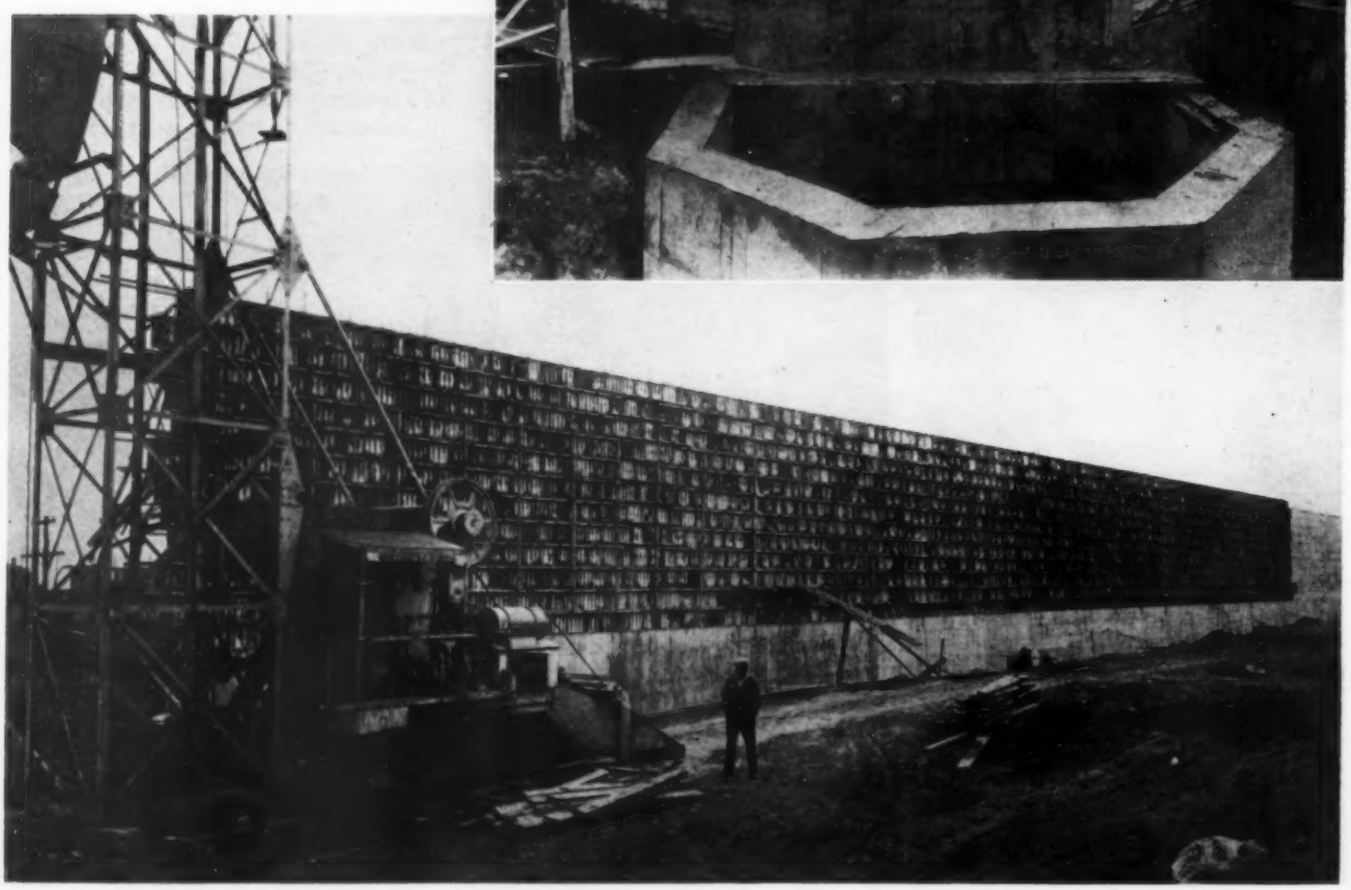
Prison Yard and Building Walls Concreted With

METAL FORM UNITS

A TOTAL of 700,000 sq.ft. of concrete surface requiring the use of forms was involved in the construction of a group of 15 buildings and a high prison wall enclosing the 35-acre tract of land on which is located the new Northeast Federal Penitentiary, at Lewisburg, Pa. The main enclosure measures 1,250x960 ft. and the wall around it, built with its top level, varies in height from 29 to 46 ft., depending on the uneven contour of the ground. At the top the wall has a uniform thickness of 12 in. which is increased by a batter of ¼ in. per foot, to a base thickness of 24 in. for the maximum wall height of 46 ft. Expansion joints are placed at intervals of 50 ft. and are covered by brick pilasters.

The plan for concreting both the yard and the building walls, as developed by the Great Lakes Construction Co., of Chicago, involved the use of 27,000 sq.ft. of steel unit forms supplied by the Metal Forms Corp., of Milwaukee. During the course of the work the contractor made 26 re-uses of this equipment. The only wood involved in the form work was a supply of 2x4's employed as horizontal and vertical aligners and some lumber for footings and bracing. The progress schedule on the yard wall provided for the erection and pouring of forms for

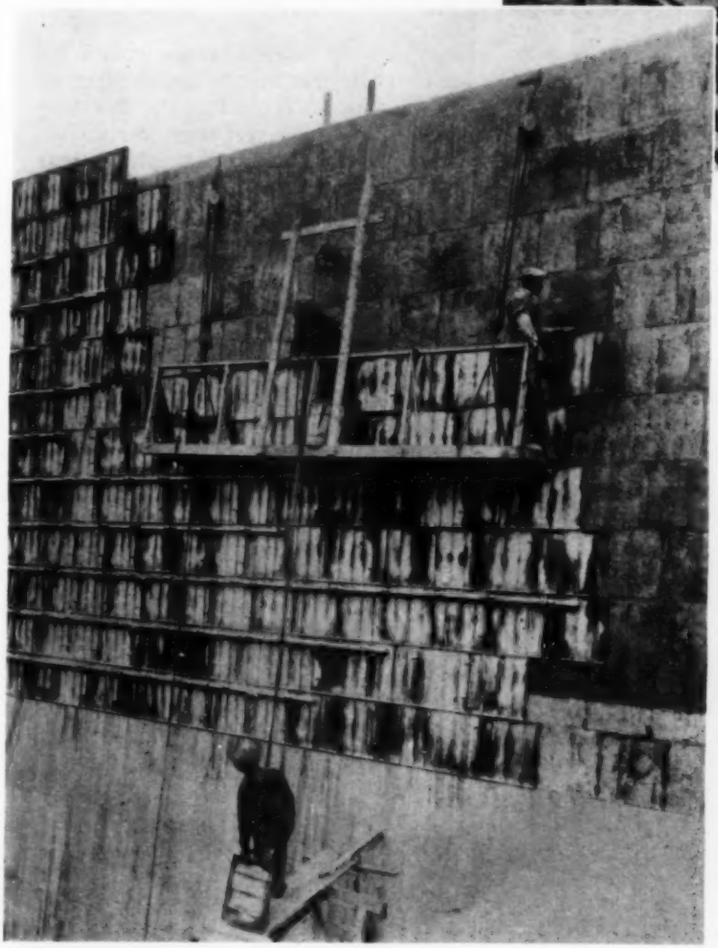


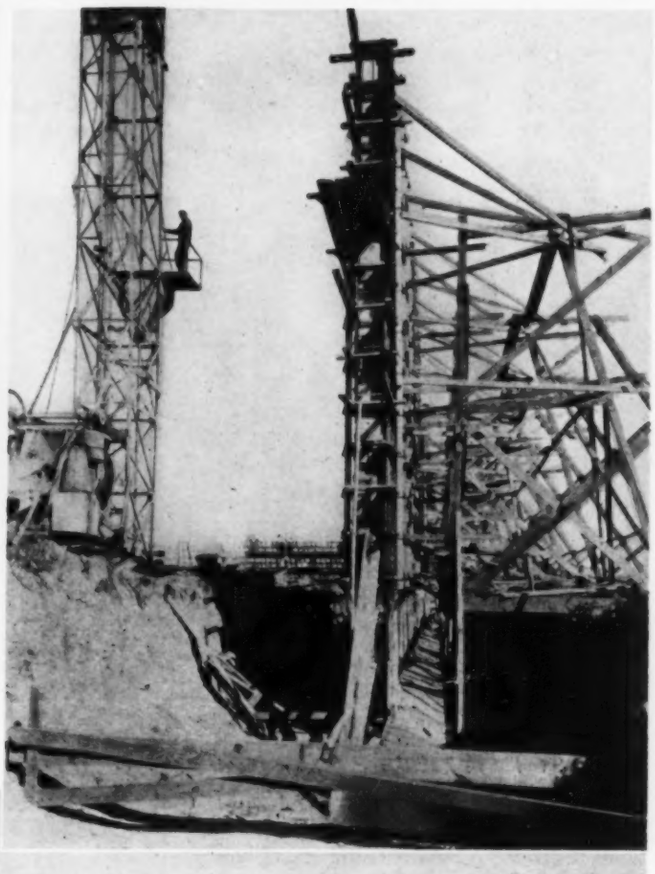


PORTABLE MIXING AND PLACING PLANT consisting of paving mixer and steel hoist tower concretes each day three sections of prison wall 50 ft. long and 24 ft. high. Wall at this point is 32 ft. high. **STEEL PANEL FORMS** *(above)* are used in concreting walls of irregular design.

FOUNDATION WALLS *(right)* of prison buildings requiring about 350,000 sq.ft. of forms are built with steel units re-used many times.

CONCRETE SURFACE *(below)* exposed by stripping steel forms is smooth and dense, eliminating need for cement wash.





three 50-ft. lengths of 24-ft. high wall per day.

The concreting plant comprised a 1-yd. crawler-mounted Smith paving mixer equipped with a steel-frame tower and hoist bucket (as illustrated in one of the photographs), one 1-yd. mixer without tower and 9 smaller capacity mixers, the latter being employed mainly on the concreting of the 15 buildings included in the penitentiary project. The mixing time specified was 1¼ min.

The yard wall forms were held in place by truss bracing on one side only and stripping of the metal units was done from a wooden scaffold. The smooth steel surface of the forms eliminated expensive patching and finishing of the exposed concrete wall surfaces.

FOUR WOOD TRUSSES on one side only brace each of three 50-ft. sections of steel forms for wall 26 ft. high. CROSS-SECTION OF WALL FORM *(above)* with bracing trusses on one side and concrete tower on other.

New Highway Traverses Smoky Mountain National Park

A RECENTLY completed road across the Smoky Mountain National Park in North Carolina probably has set a record for highway elevation (5,063 ft.) in the eastern part of the United States. When the federal government agreed to accept some 427,000 acres of rough, isolated mountain country in eastern Tennessee and western North Carolina from those two states to establish a national park, the area was totally lacking in highways. Much of the territory was covered with virgin timber and possessed practically no population, making up one of the wildest sections of the entire eastern part of the country.

As a part of their agreement with the federal government, the states have undertaken extensive improvements in their highway systems adjacent to the park area. This program calls for two roads partially skirting the borders of the park and for a third road straight across the middle of the area.

Because the park when improved and completely open to the public is expected to have several times as many visitors annually as any of the great parks in the western part of the country, handling of traffic is one of the chief engineering problems to be solved. Provision of adequate highways in the exceptionally broken country calls for heavy grading and large expenditures.

Accompanying photographs made during the grading of a 12-mi. section of the cross-park highway give some idea of the character of the country and the conditions met. For organization reasons, the North Carolina State Highway Commission built this section of highway with its own equipment and forces.

All of the 360,000 yd. of excavation, most of which was rock, was handled by two 1-yd. shovels in a period of 440 working days. Much of the spoil was side-cast to make fills on the sides of steep mountains. Where spoil had to be moved from cuts, motor trucks served the shovels.

Drilling was done in advance of the shovels with jackhammers furnished with air from portable compressors that literally had to be dragged to position over much of the job. For drilling ditches in rock and similar operations after the main grading had been completed, a portable compressor moved from place to place with a 10-ton crawler tractor was found effective.

All streams crossing the highway are carried in invert-lined corrugated metal culverts. As the rainfall near the summits of the mountains is heavy and the slopes steep, the runoff is rapid. With careful protection against scour, the metal culverts are considered satisfactory for the purpose.

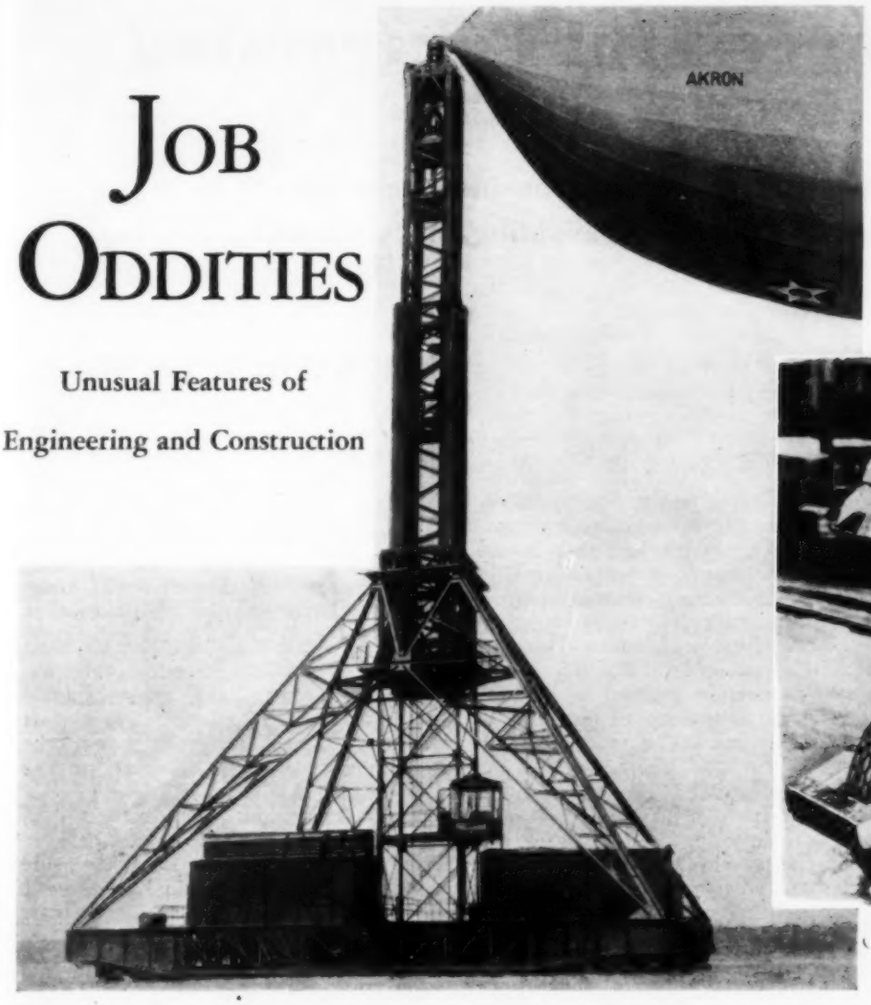
L. R. Ames is state highway engineer of North Carolina, J. C. Walker is engineer of the division in which this project is located, and B. S. Marsh was resident engineer in charge. The surfacing of the 12-mi. section is being done under contract by Nello L. Teer, of Durham, N. C.

PORTABLE COMPRESSOR drawn by tractor supplies air to hand drills cutting ditches in rock.

POWER SHOVEL operating in virgin-timber country loads rock from cut into truck.

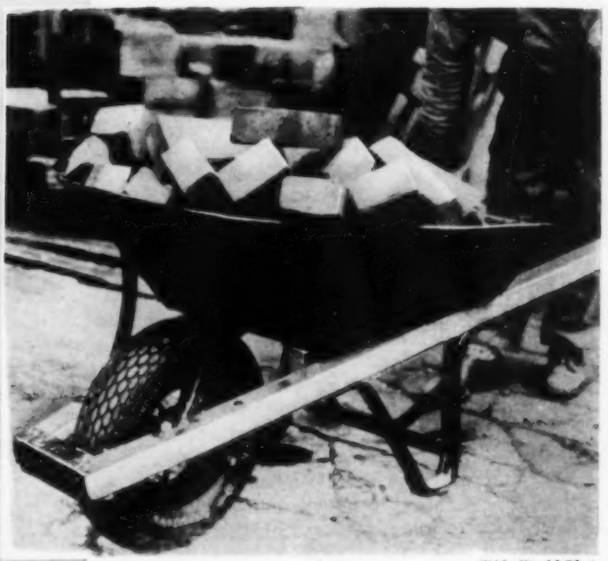
JOB ODDITIES

Unusual Features of Engineering and Construction



TRAVELING TELESCOPIC MOORING MAST *(left)* designed and built by Wellman Engineering Co., of Cleveland, for Lakehurst, N. J., air station of U. S. Navy can moor ship at maximum height of 160 ft. and minimum height of 75 ft. above ground. It can resist side pulls of 1,000 lb. at full height.

DOUGHNUT TIRE *(below)* for wheelbarrows has been developed by Goodrich Rubber Co. to give better traction and make pushing easier in sand and mud.



Wide World Photo

AFTER CRASH *(below)* at National Air Races, Universal truck crane, kept in constant attendance during meet, quickly clears away wreckage, permitting program to continue without interruption.

LONG CULVERT of Armco 12-gage dipped and invert-paved 30-in. pipe conducts water 165 ft. from top of hill down steep grade and under California coast highway and railroad. California highway department installed number of similar culverts to prevent slides on hillside.

Helps to Successful Contracting

Third of a series of articles on applying business principles to construction and making profits by avoiding costly mistakes

III—Preparing Bid Prices

By HARRY O. LOCHER
Contractor, New York

TWO WEEKS had been spent in the careful preparation of bid figures by a nationally known contracting company. It was thought that nothing had been overlooked. On the day bids were to be received the figures were given a final review. The major item was rock excavation, and after a great deal of deliberation it was decided to cut 40 cents per yard from this item. When the bids were opened the low bidder was more than $5 per cubic yard under this concern's unit price for rock. How could such a discrepancy possibly occur?

There are many reasons for such differences in bid prices—they are occurring every day. In this particular case it had been a good many years since the company referred to had had any experience in this particular class of work. It had not kept close tab on improved, labor-saving equipment and methods, which have a vital effect on costs. It is not possible to keep abreast of advances in new equipment and improved methods without making a deliberate and systematic effort to do so. It is equally important to be in the game and have first-hand knowledge of this evolution of machinery and methods.

"Every day contractors are bidding themselves into tight places by neglecting to put enough price on the items of early performance."

This brings to mind what was said in a former article about the value of personal experience, either in possession of the contractor himself, of some competent member of his organization or of some dependable authority from the outside. In these days of rapidly changing practice, sensible and logical prices cannot be arrived at without giving every consideration to how much in actual money and time these changes amount to. Too often the contract, plans and specifications are not studied carefully enough to insure safe bid prices.

A Costly Contract—On a certain close-figured levee contract no account whatever was taken of the fact that in one location 15,000 cu.yd. of material, and in another, 140,000 cu.yd., instead of being cast into the work, had to be hauled in from a considerable distance. This was due to two reasons: First, an abrupt change of direction in the line of work and, second, a scarcity of material at both these points. The contractor, inexperienced in this kind of work and without competent advice, entirely overlooked the two conditions mentioned above, both in going over the work and in the plans. He based his bid price largely on what work was generally bringing in that particular section. He had to sublet this extra work at a big price and it was one of the main reasons why his general contract showed no profit. Had he known that the expensive equipment he intended to use was totally unfitted to do this extra work, he could have arranged for sub prices at the beginning and thus protected himself. Later, when he was caught, it was but natural that he should have to pay a good, stiff price for this extra yardage.

On another contract the contractor, who was extraordinarily resourceful and far-seeing, made a particularly thorough examination of the plans and specifications, with competent assistance, and evolved ways and means of making substantial savings in carrying out certain portions of the work. He used excavation for concrete aggregates and surplus materials as necessary backfill—all in methodical sequence. This was the important feature in the whole proposition and he knew it would reduce costs. The result was that his bid was low. The job was handled with such speed as to evoke from the late Frederic P. Stearns, the chief engineer, the most enthusiastic praise. Here was a thorough, practical working out, from a close study of the site, plans and specifications, in advance, of ingenious methods which resulted in material savings, and in the expediting of the completion of the work which, of course, meant lower bid figures, the award of the contract and the opportunity of earning a larger profit from it. It is seldom indeed that a real close study of plans will not reward the contractor by disclosing procedure and methods of doing things that will mean material savings and, in some instances, improve the structure. Plans are too generally studied for the sole purpose of building the structure, rather than for discovering methods and short cuts that will lower bid prices and increase possibilities of profit.

Check Quantities—Sometimes the careful contractor may have reason to doubt the accuracy of the quantities given. If there is any such doubt he should take every means possible to check up the figures. It has often happened that a price has been put on a certain item which, due to increase or decrease in volume in this particular item, has made a vast difference in the final outcome of the contract. Two typical illustrations will indicate both sides of this situation:

Among the items of a large contract on a certain waterway, one was for a few hundred yards of riprap. The contractor in this case, practical, far-seeing and thoughtful, felt sure that this riprap item, before the completion of the work, would run into large yardage, and that by putting a good price on it and a very close price on all other items, his bid on the contract would be low. He would have a great deal to gain, and small chance of any substantial loss, were he awarded the contract. So he bid that way. He was low bidder and, as his practical vision had told him, the riprap item turned out to be the major item of the contract, yielding a handsome profit to this keen and farsighted contractor.

"While sub prices can be secured after a contract has been awarded, the opportunity for getting lower prices—increasing the probability of being low bidder—is much better *before* the bid is put in than afterwards."

Here is an example of the reverse of the foregoing situation: On a large contract in a certain city a big portion of the work consisted in the demolition of old buildings. One of these buildings was a very large structure and, according to plans, was one of the first to be demol-

ished and removed. The contractors, to get the advantage of early profit, figured much of their gain in the demolition of these buildings and particularly in the large structure. Work had hardly begun when the principals decided to demolish this big building themselves. The contractor protested, but to no avail. The matter is now pending in the courts.

These illustrations go to show the importance of determining, if at all possible, the accuracy of quantities and, particularly, those quantities in which there is some doubt as to what the ultimate amount will be and the certainty of performance of specially priced items.

"Plans are too generally studied for the sole purpose of building the structure, rather than of discovering methods and short cuts that will lower bid prices and increase possibilities of profit."

It is always good business to price liberally items which nominally do not amount to much. It makes little difference in the sum total of your bid price, and if the items are subsequently increased you are much the gainer. This may seem like elementary advice, but the practice isn't always followed. More than once, to the writer's knowledge, a low price has been placed on a small item, only to have the quantity increased and a considerable loss incurred. Then again, items are "rounded" out of all proportion to their final measure and more than once contractors have suffered severe losses by depending upon quantities which proved to be only "rounded" quantities. When a certain item or items may make a vital difference in the final results of a contract, the accuracy of the quantities and the prices put on them should be given close and thoughtful attention. Here is a loophole for possible losses and a possibility for additional gains.

Unbalancing of Bids — Unreasonable unbalancing of bids is strongly objected to—it may even mean disqualification of a bidder. Reasonable unbalancing, however, is resorted to by most prudent contractors and not objected to by principals. More than one large tunnel contract has been almost entirely financed for the general contractor, before he ever struck a tap, from the profit he received in subletting his shafts on which, of course, he had put an unbalanced price. Strange as it may seem, there are many contractors who do not take enough advantage of putting an additional price on the items to be done first and who later get into financial difficulties for lack of operating capital. Of course, with ample resources this practice is not important, but a contractor who has to make his dollars go as far as possible should take every advantage of legitimate unbalancing. The owner or principal is almost always in better condition to finance the work than the contractor whose function is to build it. This may all sound elementary, but every day contractors are bidding themselves into tight places by neglecting to put enough price on the items of early performance.

In talking about a certain concrete-lined tunnel job, one contractor said to the writer not long ago: "If we had had sense enough to put some of the concrete price on the excavation, we'd have been all right. But we did just the opposite, thinking the excavation would go along pretty smoothly and we'd have a good price on the concrete at the wind-up. We hit water and had to slow up and we are not carrying ourselves. We have a fine price on the concrete lining, but we should have slipped a little of it into the excavation price."

Another contractor said: "Wouldn't we have been in a nice mess if we hadn't put plenty of price on the early work." In this case the early work cost much more than had been anticipated and had the contractor not fortified himself against it, he would have suffered a heavy loss.

Figuring Prices—The preparation of bid prices is too frequently not given the attention its importance deserves. While other bidders' prices on similar work in the same locality are a considerable help, no prudent contractor should depend upon them entirely, even with the addition of some superficial so-called figuring. Prices should be carefully figured by several members of the organization, separately, and also, in certain cases, by an outsider. Then, the prices arrived at should be compared, discussed and agreed upon. All experienced contractors and their principal men know what go to make up general costs, but there is often a difference of opinion as to what certain items will cost, what rate of progress or volume of output can be expected, and what unprovided-for contingencies affecting costs may or may not come up.

Each man preparing figures should take each individual item and go into it with the utmost care, applying to it all of his own experience, the experience of others he is familiar with, and the prices of other responsible bidders, bidding in the same locality. When several men have prepared bid prices in this manner, followed by a comparison and discussion, final prices are arrived at which are as safe and sound as can be expected. The final figures in a meeting of this sort should be decided by consensus of opinion, after taking every factor into account, and not by the individual opinion of some one man who may have the authority to say the final word. Of course, he may be able by example, reason and logic, to convince the others, but if his final say is in direct opposition to what is generally thought is the right price by a group of experienced, competent men, it most always happens that he is wrong, and a good job is thus often lost.

Sub Prices—Sub prices, of course, must always be taken into account when preparing a bid, if it is expected to sub a part of the work. While sub prices can be secured after a contract has been awarded, the opportunity for getting lower prices—increasing the probability of being low bidder—is much better *before* the bid is put in than afterwards. A subcontractor is in a much better position to ask a higher price after the general contract has been let than before. There have been situations in which general contractors paid dearly for not getting sub prices on certain items before putting in their bids.

NEXT MONTH

The fourth article in this series by Mr. Locher, to appear next month, will discuss

"Construction Equipment and Methods"

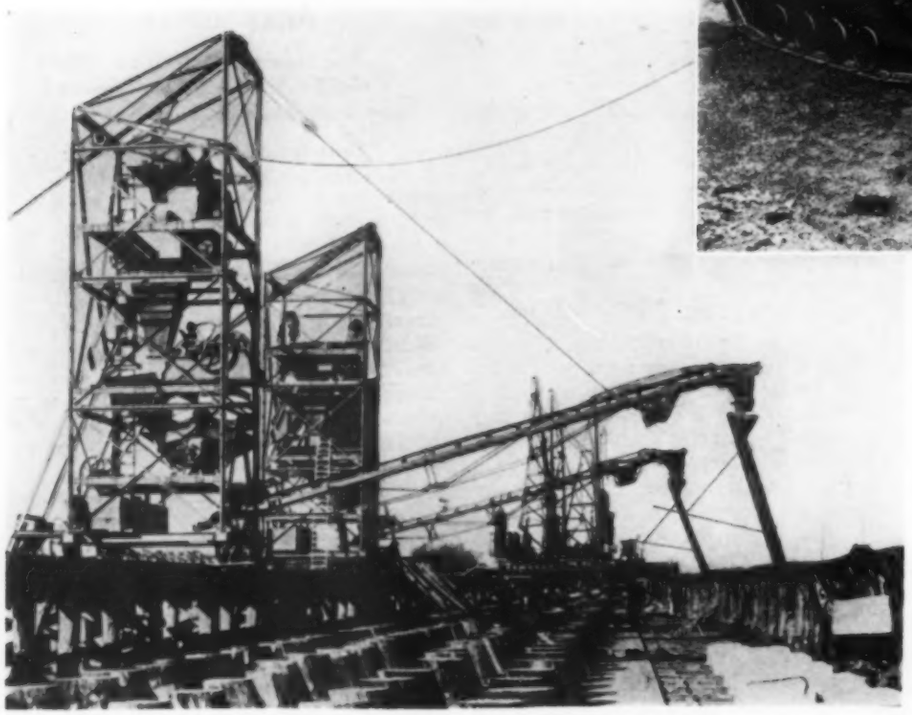
The extra material in the levee contract mentioned previously is a typical illustration. The general contractor secured competition of a sort in this instance, but there is no question of a doubt that all bids he received naturally included something which was based on the fact that he was "up against it." Such situations have developed time and again. Before bidding is the time to get advantageous sub prices, prices which might prevent an ultimate loss either by not being awarded the contract, or by knowing in advance that certain difficult portions of the work carried a sure profit. This brings us to the responsibility of subcontractors, which we will discuss, later, at greater length.

Before concluding this article on bid prices, however, it must be said that perhaps there has never been a time when contract work could be sublet as advantageously as now with, of course, its direct influence on general contractor's bids. There are a vast number of experienced, capable, responsible, well-equipped subcontractors or contractors who would be glad to sub work and who, on account of low overhead charges, can do certain work at prices some general contractors cannot even approach. Just a few days ago a well known general contractor told the writer that the prices he got from subcontractors (before placing a bid on a general contract which was awarded to him) were nothing short of amazing. He added that he had selected only responsible men, and that they had qualified in every way. Due to their direct, personal attention, overhead and administrative charges were minimized. In other instances, actually working themselves, they could do work of certain sorts cheaper than most general contractors possibly could do it. Some of the most successful contractors in America became so by subbing work to employees who had demonstrated their worth as to character, loyalty, ability and capacity.

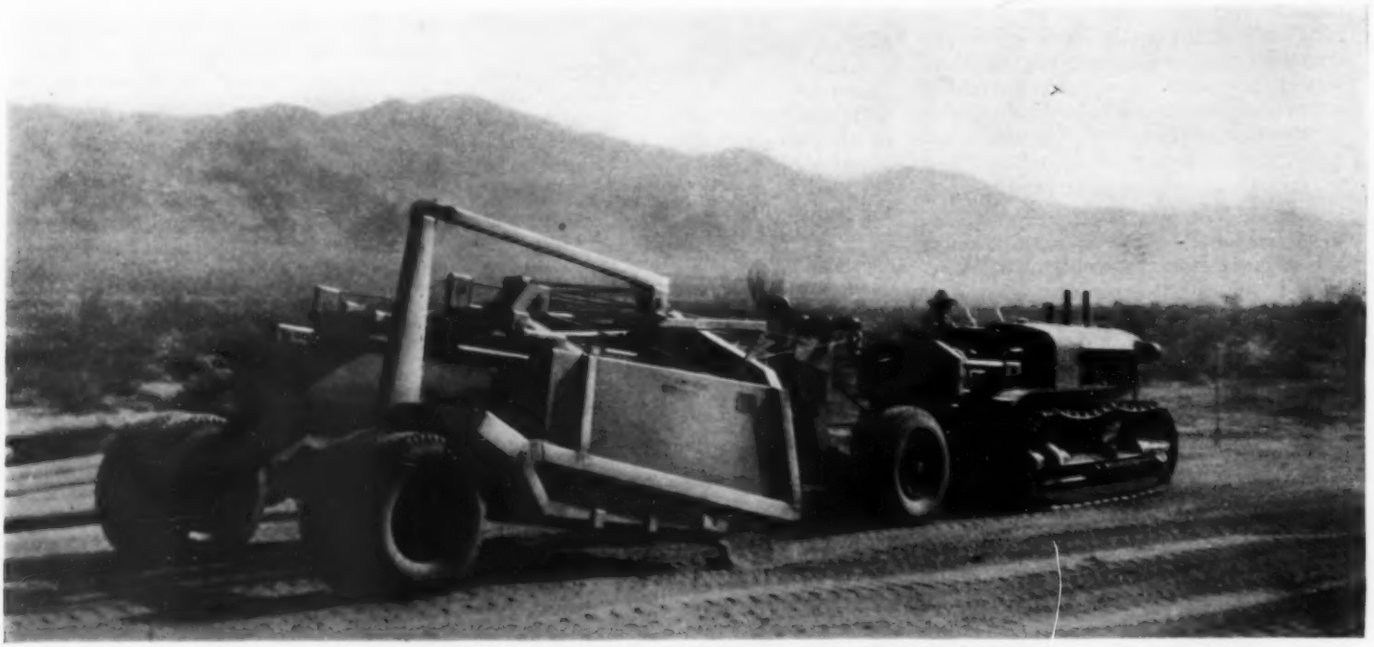
Getting Down to DETAILS

Close-up Shots of Job Methods and Equipment

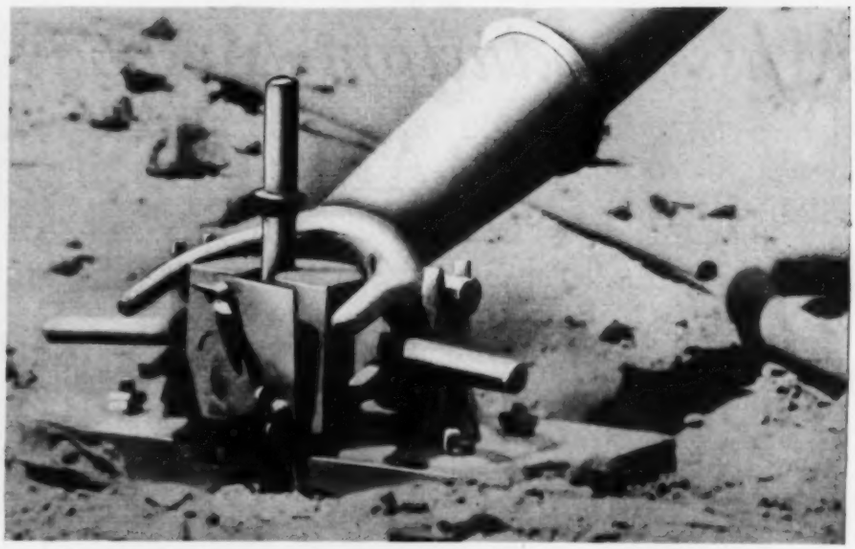
ROLLER ATTACHMENT weighing 2 tons on McCormick-Deering tractor compacts trench backfill for Cater Construction Co., of Kansas City, contractor on Kansas City section of long-distance underground telephone cable being laid from St. Louis to San Antonio, Texas.



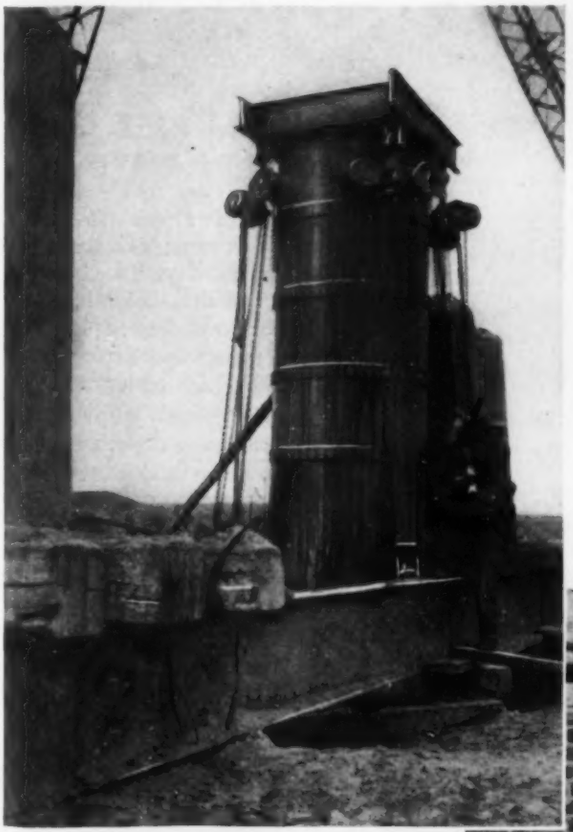
TRAVELING MIXING AND PLACING PLANTS (*left*) fed by inclined elevators and equipped with belt-conveyor booms concrete canal banks of Oberwartha hydro-electric plant near Dresden, Germany.



SIX PNEUMATIC TIRES aid LeTourneau 9-yd. carry-all scraper, drawn by Allis-Chalmers tractor operating in high gear, to move average of 500 yd. of fine sand distance of 800 ft. each hour for Basich Bros., of Torrance, Calif., on relocation of Mecca-Blythe highway in southern California.

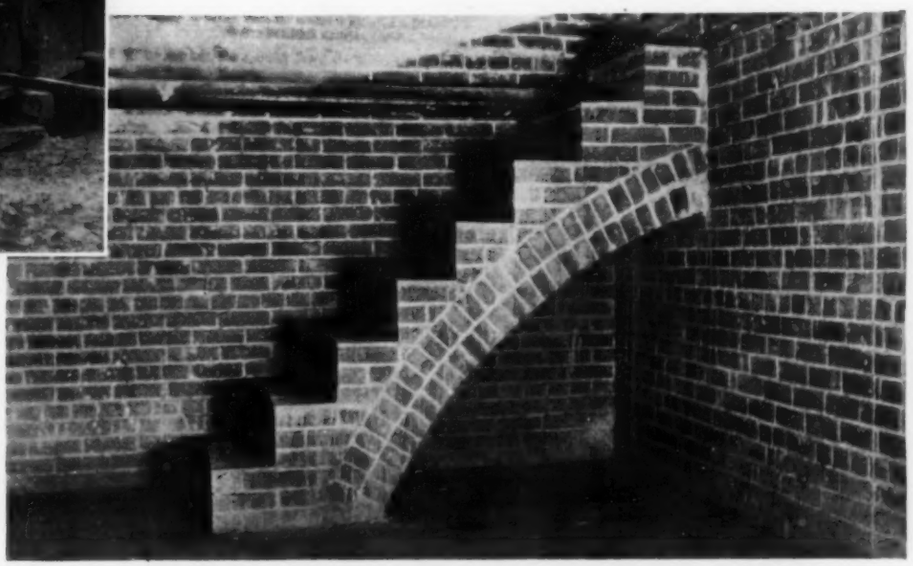


PULLER FOR STUCK DRILL STEEL invented by Edward Rawson, superintendent, California department of highways, ordinarily requires only 5 to 10 min. for setting up device and withdrawing stuck steel. As shown at right, device consists of bedplate, fulcrum chair, clamping block fastened to stuck steel, and forked lever, resting on fulcrum chair, which applies pulling pressure to arms of clamping block.



FOUNDATION CAISSONS 6 ft. in diameter are sunk 56 ft. through sand, mud, and clay-gravel to hard shale by four Yale 12-ton ball-bearing spur-geared chain hoists anchored to pair of weighted I-beams. Green Construction Co., of Oklahoma City, sank 38 caissons by this method for bridge across South Canadian River near Thomas, Okla. After excavating with Hayward orange-peel buckets and unwatering, contractor filled caissons with concrete.

TIMBER NOSE on combination steel and timber bridge built as unit of Ohio's winter program for unemployment relief protects pier during periods of high water. Nose rests on concrete footing. Timber planks are reinforced with 6-in. steel angle and are fastened to piling with lag screws and C.I. ogee washers.

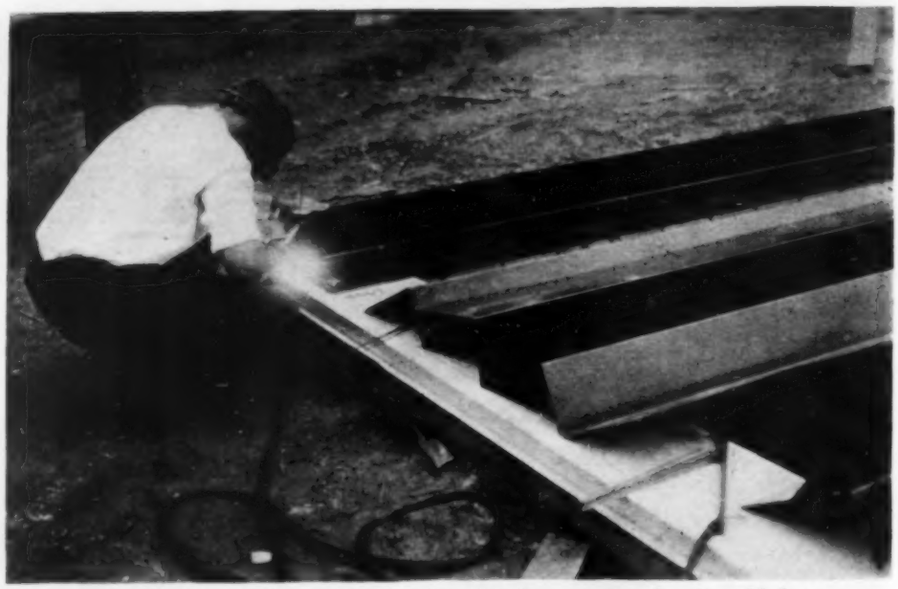


SOLID BRICK STAIRWAY in basement of San Antonio, Tex., building demonstrates practical result obtained by applying arch principle in simple masonry construction.

Mass-Production Methods Build
FRAMELESS STEEL HOUSE

DESIGNED for construction by mass-production methods with factory-assembled units of pressed sheet steel for walls and floors, an all-welded, "frameless," eight-room house, with an exterior finish of porcelain enamel shingles has been erected at Solon, Ohio, a suburb of Cleveland, by the Insulated Steel Co., Inc., in cooperation with the American Rolling Mill Co. The house was built to demonstrate the adaptability of sheet metal to low-cost home construction and was not intended to produce a standardized type of dwelling. Rather, the demonstration aimed to perfect a method of construction which could be used to reproduce any type of architecture for the individual home, thus overcoming one of the strongest objections to the factory-produced house.

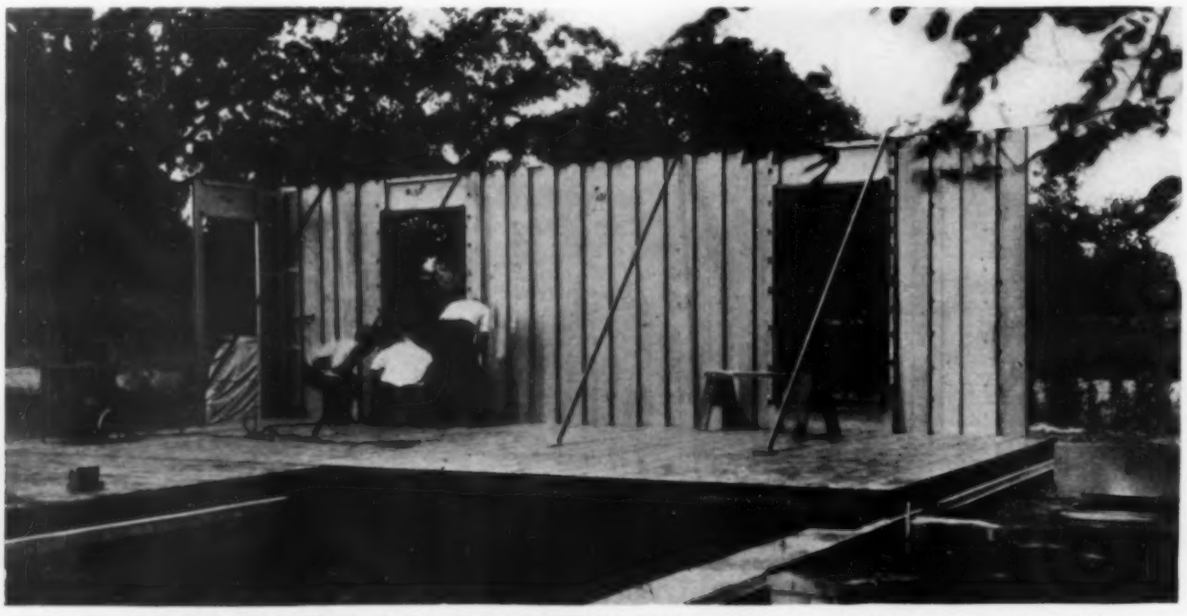
Need for a structural frame was eliminated by constructing the walls of pressed steel sheets having box-like corrugations, or channels, which stiffen the sheets sufficiently to carry floor and roof loads. Floors were made self-supporting by a cellular, box-like construction employing Z sheets. The house required 17 tons of steel, which was distributed about 6 lb. per square foot in the floors and 2.9 lb. per square foot in the walls. Both floor and wall units were sheared to length at the mill and assembled and welded in sections at the shop prior to delivery to the job.



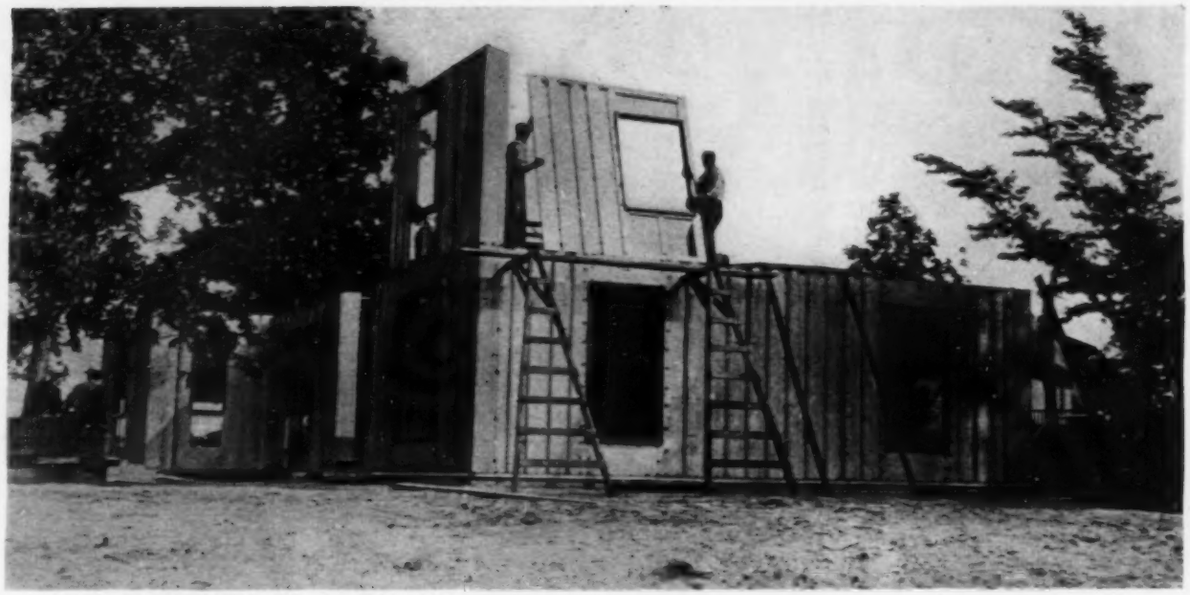
FIRST 18-GAGE STEEL SHAPE for box-like floor construction is welded to galvanized steel sill plate on masonry foundation.

Steel Load-Bearing Walls—Sheets of 20-gage Armco steel for wall construction were cut to length corresponding to the story height at the factory, and box-like channels 6 in. wide and 2 in. deep were pressed lengthwise into the sheets. The sheets are made in four standard widths, three of which were used in building the frameless steel house: 1 ft. 1 in.; 2 ft. 1 in.; and 3 ft. 1 in. In each width, the extra inch provides a surface for welding purposes only. This variation in widths provided flexibility in building walls of any desired length and eliminated cutting and fitting. In completing a wall which ended with a fraction of a foot, final adjustment was made by overlapping the channeled sheets, thus forming a hollow column in the wall.

After rust-proofing, wall units were



SHOP-FABRICATED STORY-HIGH WALL SECTION made up of channeled 20-gage steel sheets with window frames welded in place is erected as unit and welded to foundation cap and steel floor.



LOAD-BEARING WALLS of pressed steel sheets are carried up one story at a time. After second floor has been erected and welded to top of first-story walls, workmen set second-story sections on cap plate of lower wall and brace them in place for welding.

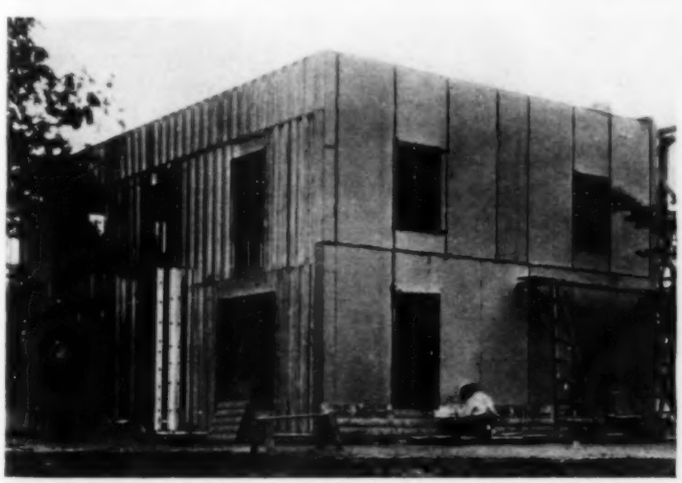
assembled and welded into room-wide, story-high sections at the factory, with metal window frames and spandrels welded in place. In assembling a wall, the portion containing the 16-gage furniture-steel window frame and spandrels was welded first, and additional sheets were welded on to complete the side of a room. After a wall section had been assembled, 16-gage header strips 2 in. wide were welded to the top and bottom to give additional rigidity, and the section then was ready to be transported to the building site.

Cellular Floor Construction—Sheets of 18-gage hot-rolled steel 28 in. wide for the floors were sheared to length at the mill and were bent into Z shapes with vertical webs 6 in. high and parallel legs 11 in. long. The Z sheets were assembled to form a series of boxes 6 in. deep and 10 in. wide, with the legs of each sheet lapped 1 in. over the adjacent sheets for welding. This construction gives great strength with light weight.

EXTERIOR CORNER DETAIL of first-story wall resting on, and welded to, foundation cap.

Erection Procedure—As the first step in erecting the superstructure of the house, a cap of 16-gage galvanized steel was placed on the masonry foundation wall. This cap had 2-in. legs turned down over the edges of the masonry, and the outside leg carried a 1-in. shelf to support exterior insulation and siding of the sheet steel wall. No bolts were used to fasten the cap to the masonry wall, as only a direct vertical lift of 2 in. could remove the structure from its foundation. The steel floor and load-bearing wall were welded to the cap.

After scribing a line on the cap 2 in. back from the edge of the foundation to mark the edge of the floor, leaving a 2-in. ledge for the channeled wall



FIBER INSULATION in large sheets 1 in. thick is attached to steel walls with drive screws, and joints are waterproofed. Workman is fastening strips of porcelain enamel shingles to wall.

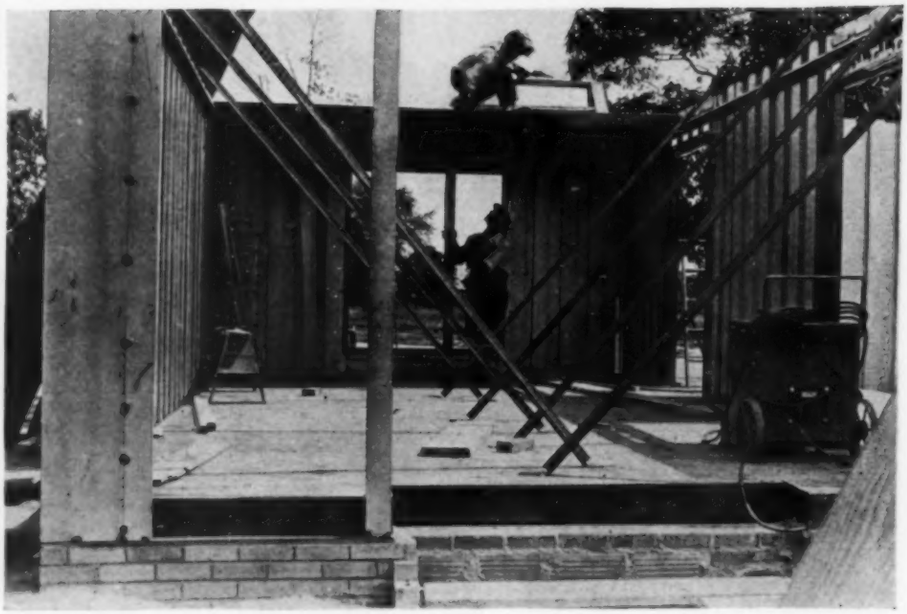
Acme photo

COMPLETED FRAMELESS STEEL HOUSE has exterior wall finish of porcelain enamel shingles, roof solarium, and built-in two-car garage. Structure is well insulated and is highly fire-resistant.

sheets, workmen placed the cellular floor sections and welded them to the cap. After completing the floor, the erectors set the large wall sections of the first story and welded them to both cap and floor.

To support the second floor, the erection crew welded a 3-in. shelf angle of 16-gage steel around each room at the ceiling line. This angle served as a temporary rest for the floor, until it could be welded to the side walls, and as a permanent conduit for electric wiring. A cover was snapped into the angle after the wiring had been installed.

Erection of the second-story walls, flat roof, and parapet walls was similar to the procedure for the first story. Because the building went up one story at a time, no scaffolding or extension ladders were required. One welding operator and two workmen erected all the steel.



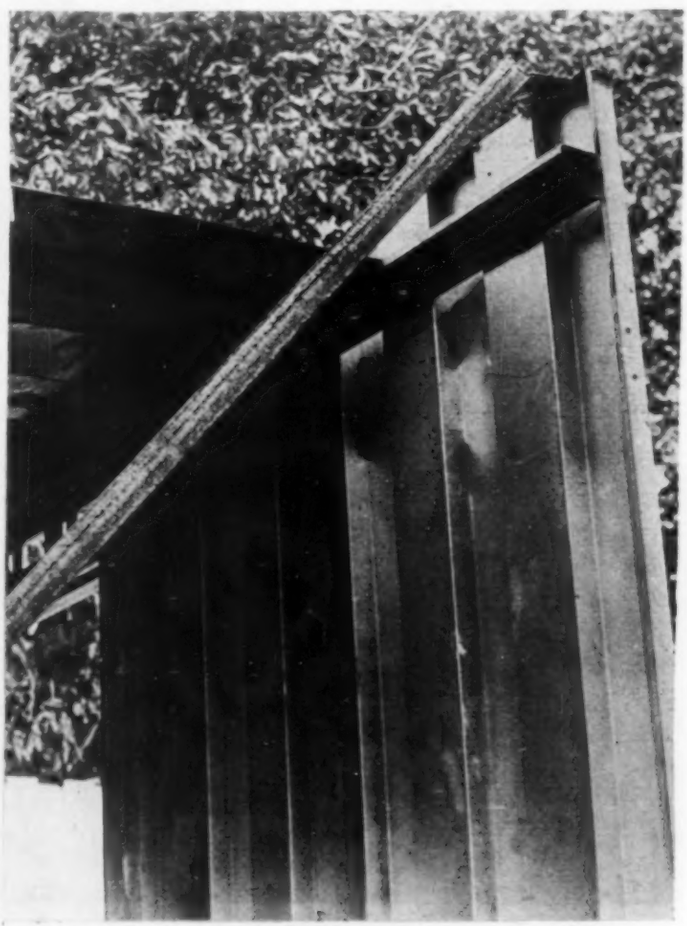
ONE WELDING MACHINE and crew of three men erect 17 tons of steel in house. Second floor rests on shelf angles pending welding to first-story walls.

Welding—All connections, both in the shop and on the job, were made by tack welding. Westinghouse FlexArc a.c. welding machines were used for most of the work at both places, as these machines were well adapted to the spot-welding of thin sheets. The easy portability of the welding machine was an added advantage in the field. A d.c. machine performed part of the shop welding.

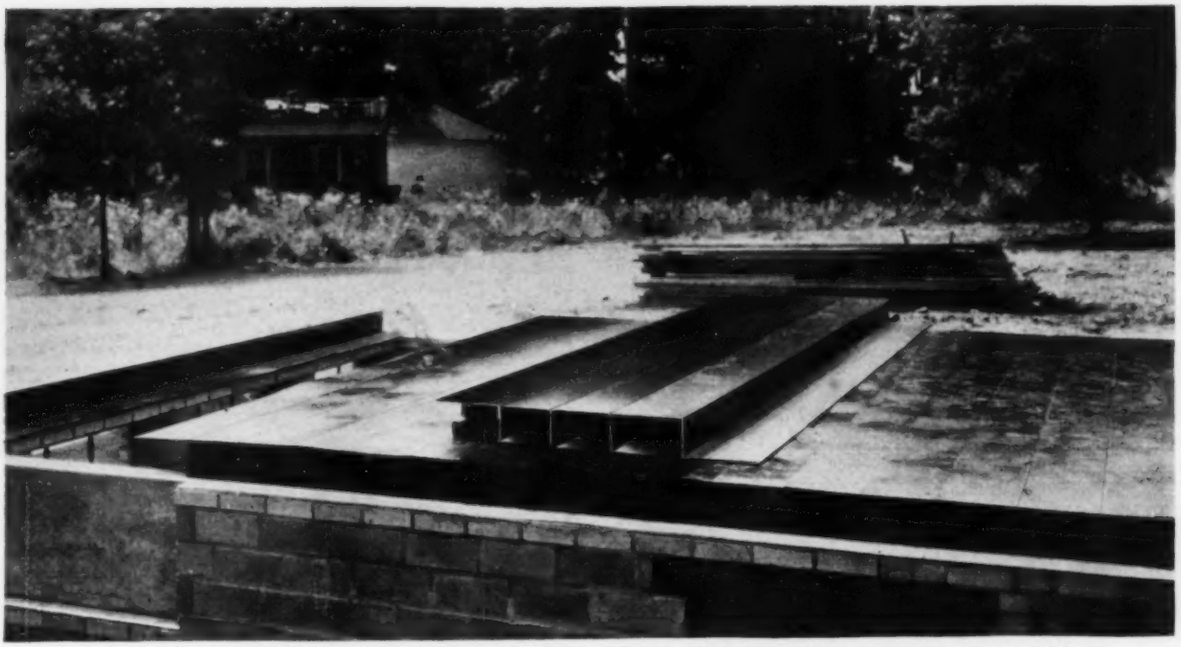
As only spot welds were required, the work of shop fabrication and field assembly went forward rapidly. Z sheets of the floors were tack welded at intervals of about 24 in. along both legs of each sheet. Channeled wall sheets were connected by spot welds about 12 in. apart, each weld requiring about 5 sec. to complete.

Wall Covering—Insulation against heat and cold was built into the wall

SECOND FLOOR is made up of Z sheets, similar to those used in first floor, erected and welded individually. Note steel cap strip 2 in. wide on wall.



ANGLE welded to steel wall at ceiling height serves as temporary support for upper floor and as permanent covered conduit for electric wiring.



SECTIONS OF CELLULAR FLOOR are fabricated in large units for assembling in structure. Series of boxes is formed by welding Z sheets to each other along edges of both legs.

by attaching a 1-in. thickness of Celotex to the outside of the steel sheets. The finished surface of the wall consists of porcelain enamel shingles, about 6 in. square, applied in strips 36 in. long. Both Celotex and shingles were fastened to the steel-sheet wall by tempered, spirally-threaded nails, or drive screws, which penetrated the sheet metal easily but which can be removed only by unscrewing them.

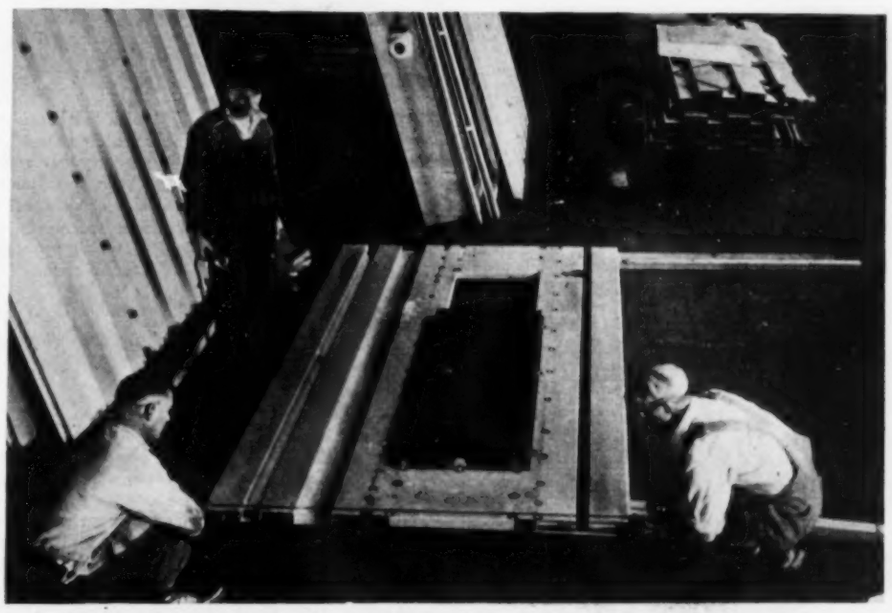
On the interior surface, gypsum wall board was applied and covered with two coats of plaster. The completed wall is less than 4 in. thick. Micarta was employed for baseboards, for a fireplace and mantel, and for the walls of one bathroom. The kitchen and a second bathroom have linoleum wall covering. It is planned to finish both interior and exterior walls of future houses at the factory.

The steel floors were covered with a layer of mastic which acts as a sound deadener and also as an adhesive for the laminated hardwood floors which were laid in the living quarters and for the linoleum which was put down in the kitchen and bathrooms. Ceilings are surfaced with acoustical tile cemented to the under side of the steel floor with mastic.

Roof—A flat roof was selected for the frameless steel house for reasons of economy and utility. One part of the roof space is occupied by a solarium, and the remainder is to serve as a porch and as a safe playground for children. A four-ply asphaltic roof was applied over insulating slab 2 in. thick. Thin pieces of slate were embedded in the asphalt to form a walking surface.

Advantages—Mills G. Clark, president of the Insulated Steel Co., Inc., designed the frameless steel house as a means of applying factory methods and modern materials to low-cost home construction without restricting the aesthetic freedom of the owner and architect. The frameless construction can be adapted to almost any shape of dwelling up to four stories high, and it permits a wide choice in wall coverings and roofs. It also is readily applicable to standardized houses. A house of this construction can be erected quickly with a small crew, it is highly fire-resistent, vermin-proof and lightning-proof, and, when properly insulated, is economical in fuel consumption.

FORMAL OPENING of frameless steel house attracts throng of engineers, architects and builders.

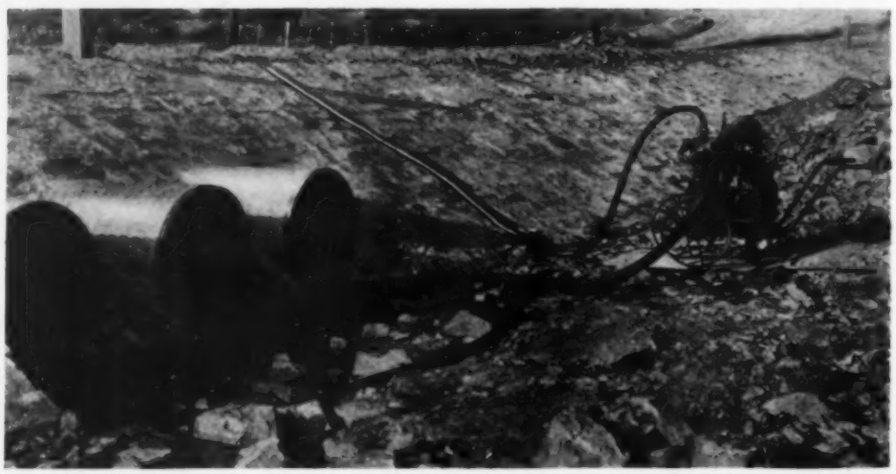


SHOP FABRICATION OF LARGE WALL SECTIONS starts with portion containing steel window frames and spandrels, which are welded in place. Channeled sheets are welded on to increase unit to desired length.

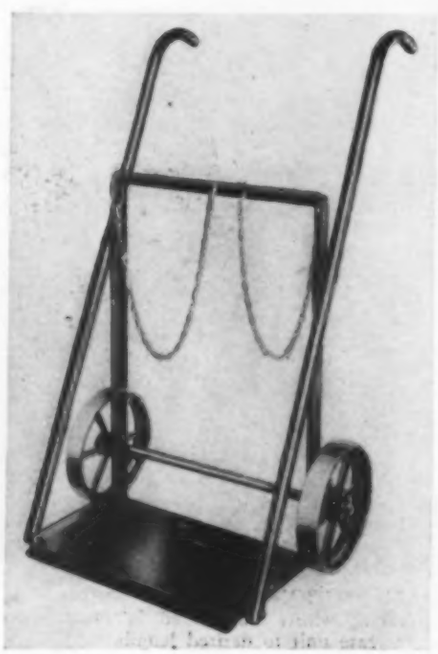
NEW EQUIPMENT *on the Job*

MOTOR-DRIVEN FLOATING MACHINE eliminates hand finishing methods and permits satisfactory use of dry, coarse mix in construction of concrete floors. When topping has been compacted and leveled, floating machine is applied. Its 170-lb. weight, together with rotation of disk, further compacts and floats out topping to smooth, level surface, bringing to the top just enough mortar for steel troweling.—Kelley Electric Machine Co., 285 Hinman Ave., Buffalo, N. Y.

HIGHWAY SURFACE HEATER for use in surfacing or resurfacing any type of pavement where base is still unimpaired. Removes old sheet asphalt, asphaltic concrete and bituminous surfaces. Method consists of heating surface with blast of hot air, without flame, for 1 to 1½ min., after which dead material is scraped off. Spray of asphaltic cement then is applied and surface cooled. Finally hot top course mixture is placed, raked and rolled in regular way. Machine built in and on framework for mounting on any type truck. Will treat 1,500 sq.yd. of pavement in 8-hr. day.—Good Roads Equipment Corp., 50 Church St., New York City.



2-IN. SELF-PRIMING CENTRIFUGAL PUMP features leather seal which is used to replace ordinary packing, requires no attention and is air and water tight. Capacity 75 g.p.h. at 15 ft. lift and total head of 55 ft. Operated by 2-hp. engine. Mounted on 2-wheel truck, on rubber tire spring-mounted trailer, or on skids. — Novo Engine Co., Lansing, Mich.



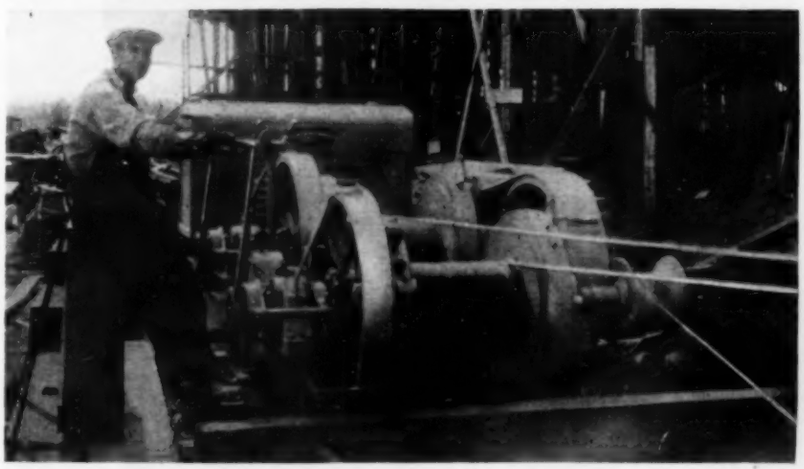
CYLINDER TRUCK for handling welding and cutting equipment, insures firm support for oxygen and acetylene cylinders, eliminating possibility of overturning them and breaking regulators or gages. Frame of 1¼-in. angle iron; handles of 1¼-in. pipe. Equipped with 12-in. cast-iron wheels with 2-in. tires. Overall size: 48 in. high; 30 in. wide. Weight, 80 lb.—Linde Air Products Co., 205 E. 42nd St., New York City.

New Sales Outlet for Cletracs

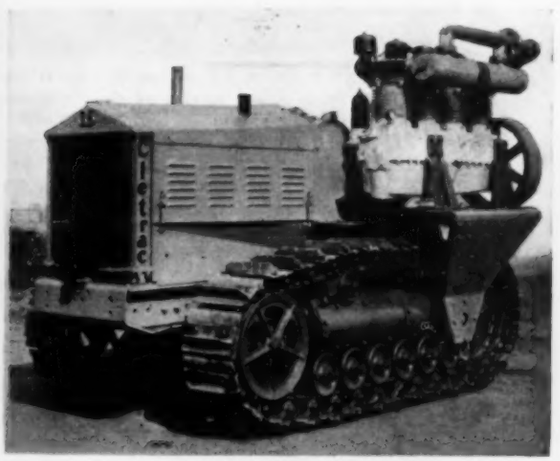
The Cleveland Tractor Co. and the Austin-Western Road Machinery Co. have completed a sales and service agreement for the distribution of Cletrac crawler tractors in middle-western and southern territory comprising the states of Michigan, Wisconsin, Minnesota, North Dakota, South Dakota, Nebraska, Iowa, Illinois, Indiana, Kansas, Eastern Missouri, Oklahoma, Texas, Arkansas, Louisiana, Mississippi, Alabama, Georgia, Florida, North Carolina, South Carolina, Tennessee (in part), Virginia and West Virginia. The Cletrac line will be on display in all principal cities and trading centers in this territory and will be sold and serviced through the combined efforts of the present Austin-Western organization and the Industrial Sales Division of the Cleveland Tractor Co. The plan will not be extended beyond the territory indicated, and similar working arrangements hitherto made by the Cleveland Tractor Co. in other territories, with other grader and road machinery companies, will not be disturbed.

SHOULDERING ATTACHEMENT *(right)*, developed for use with Western No. 6 elevating grader in place of plow, builds shoulder true to line and grade. Consists of blade fastened to frame attached to grader; an outer auxiliary blade for cutting slope to ditch, and screw conveyor to carry excess material to elevator belt for loading into trucks and wagons. Blades can be adjusted for any slope desired.—Western Wheeled Scraper Co., Aurora, Ill.

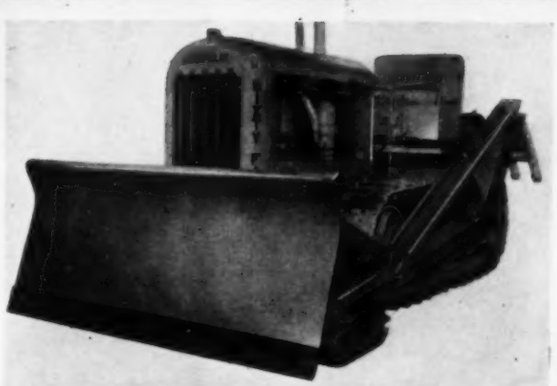
INSULATED, WATERPROOFED STEEL-DECK ROOF *(left)* provides acoustical correction for auditoriums, gymnasiums and other large rooms. Consists of standard Truscon Ferrobord 6-in. wide made of 18- or 20-gage steel sheets having a double-flanged rib on one edge which interlocks with a single flanged rib on the adjoining sheet to form structural supporting members at 6-in. intervals. These ribs may be 1¼ or 1¾ in. deep, depending upon load. Surface forms smooth tight deck. Acoustical treatment consists of any acoustical board made to fit between ribs of Ferrobord which is welded to purlins after board is inserted. This ceiling has sound absorption value up to 80 per cent at 512 cycles.—Truscon Steel Co., Youngstown, Ohio.



HEAVY-DUTY HOIST, for dragline work, steel erection, pile driving, clamshell bucket handling and high speed material hoisting, has multiple V-belt drive consisting of two sheaves and seven V-shaped ropes which fit in grooves on sheaves. Powered by 6-cylinder, 65-hp. Waukesha gasoline engine or 50-hp. electric motor. Hoisting speeds: On 12-in. drum, 220 ft. per minute; lagged to 18-in. diameter, 275 ft. per minute; lagged to 30-in. diameter, 440 ft. per minute. —C. H. & E. Manufacturing Co., 120 E. Mineral St., Milwaukee, Wis.



TRACTOR-COMPRESSOR UNIT consists of special Cletrac tractor mounting designed to accommodate Davey 4-cylinder, air-cooled compressor having capacity of 320 cu.ft. per minute. Two compressors, having combined displacement of 640 cu.ft. per minute, can be mounted on Model 80 Cletrac and driven by independent sets of V-type belts. Under test speed of 750 r.p.m., dual compressors show efficiency of 72.5 per cent at 100-lb. pressure; 76 per cent at 90 lb., and 80 per cent at 80 lb.—Davey Compressor Co., Kent, Ohio.



HYDRAULIC BULLDOZER *(above, right)*, for use on Caterpillar tractor. Designed so that tractor drawbar is in clear at all times thus permitting tractor to perform usual duties without removing any part of bulldozer. Both up and down pressure may be used on blade which has a 34-in. high lift above ground level and an 18-in. drop below. Control lever for handling bulldozer placed within convenient reach of tractor operator.—La Plant-Choate Manufacturing Co., Cedar Rapids, Iowa.

If You Want Further Information—

Within the space limits of these pages it is impossible to present complete information about the products illustrated.

The manufacturers, however, will be glad to supply further details if you will write to them.

Present and Accounted For —

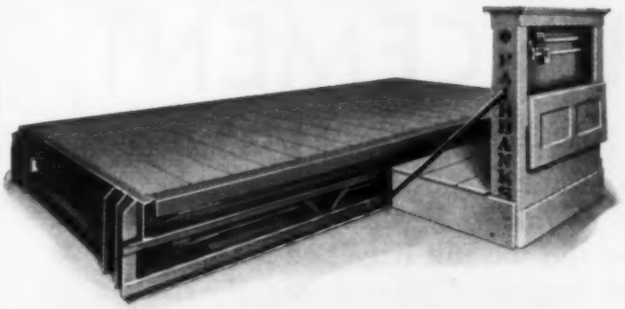
A Page of Personalities

ROBERT RIDGWAY, at age of 70, on Nov. 1 retired from active service as chief engineer of Board of Transportation of New York City. For almost 50 years he served city in various engineering capacities, starting in 1884 as leveler on Croton aqueduct, acting as department engineer on the Catskill aqueduct, and retiring as chief engineer of almost-completed $650,000,000 independent subway system.

CLYDE G. CONLEY, president and treasurer of Mt. Vernon Bridge Co., Mt. Vernon, Ohio, is newly elected president of American Institute of Steel Construction. Mr. Conley has been associated with Mt. Vernon Bridge Co. in engineering and executive positions of increasing importance since 1902.

JULIAN L. SCHLEY, on Oct. 13, was appointed by President Hoover governor of Canal Zone. Following experience as engineer-executive in United States and commander of 307th Engineers in France, Col. Schley in 1928 was appointed engineer of maintenance, Panama Canal.

H. J. FIXMER, president of Illinois Society of Engineers, has served for 27 years as division engineer of Board of Local Improvements, Chicago. In last 2 years he has directed widening and paving of Ashland Ave., Northwestern Ave. and North La Salle St.



A truck scale that you can move *easily* to the job

AGAIN, Fairbanks, by closely watching the needs of the industries it serves, produces a scale which fits *exactly* the requirements of contractors.

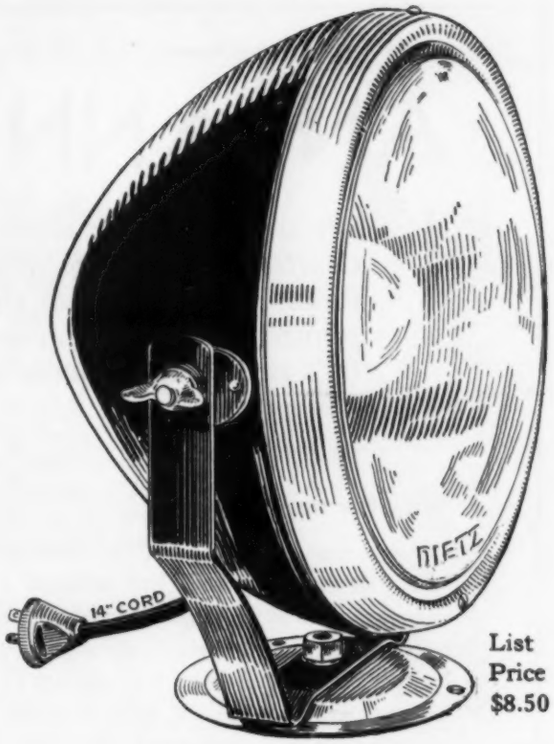
For checking receipt and disbursal of aggregates—for weighing aggregates as a basis of payment for the job (a growing practice in many states)—Fairbanks has produced a self-contained Truck Scale *which can quickly and easily be dis-assembled and transported from job to job.* On a paving project, for example, this scale can be advanced along the job with the mixers or pavers.

Full descriptive literature may be obtained by writing nearest branch or Fairbanks, Morse and Co., 900 S. Wabash Ave., Chicago. And 40 Principal Cities—a service station at each house.

Fairbanks Scales

PREFERRED THE WORLD OVER

8815-BA31.11



List Price $8.50

DIETZ "Economy" FLOODLIGHT

The Light of a Hundred Uses

At low cost an equipment of Dietz Economy Floodlights will solve your problem of lighting for emergency night work on sewers, water mains, highways, or around buildings.

The same high standards of quality and durability which characterize other Dietz lighting devices are built into this Floodlight. It sheds a powerful, wide angle light and is fitted with hyperbolic reflector, chromium plated, with a 100 watt, 115 volt bulb (user can substitute a 32 volt or 220 volt bulb if desired). The body is of steel, black enameled, with cadmium plated door rim, base and mounting nuts. It is water proof and weather proof.

Order through your Supply Dealer. Circular sent on request.

R. E. DIETZ COMPANY
NEW YORK

Makers of Lanterns for the World
FOUNDED 1840

AN ANNOUNCEMENT

We are pleased to announce that effective with the January issue, *Construction Methods* will appear in a new and greatly improved form. Beginning with that issue *Construction Methods* will be printed by the rotogravure process and the full page size will be increased to approximately that of large-sized general magazines.

Why the new form?

Construction Methods, published since 1926 for "methods-minded" men, has attained a pre-eminent position throughout the engineering-construction industry largely through its graphical presentation of better construction practice. The rotogravure process with its more vivid reproduction, and the larger reading pages with larger illustrations, more effectively presented, will markedly enlarge the opportunity to serve the reader.

Why are we making this change now?

The readers of *Construction Methods* are interested chiefly in the practical methods and details of construction. Graphical presentation is particularly effective in meeting their needs, so improvement in the service of the paper naturally would center upon more effective pictorial treatment. Fortunately the new format makes it possible at the same time for the advertiser to realize important qualities of greater visibility and impressive layout combining to produce advertising of exceptional power. With creative selling the order of the day, and the need for advertising effectiveness greater than ever, we feel that now the opportunity is peculiarly ripe for making this change to benefit both the reader and the advertiser.

What are the advantages to the advertiser?

The distinctive nature of the new *Construction Methods,* with its heightened reader interest, provides a basic increased value to the advertiser. In addition, the full-page size, being 43% greater in area, together with the more attractive printing process, will materially increase opportunities for *unusual advertising display and layout. Thus the hitting power of an advertisement is greatly increased.*

What is the new Construction Methods going to look like?

Produced by the rotogravure process illustrations will appear in a rich deep brown. Type matter and line drawings will reproduce almost black and will give the entire page a striking duotone effect. Without question the new *Construction Methods* will be one of the outstanding industrial publications in any field from a standpoint of appearance—certainly the most distinctive and most talked-of monthly publication in the engineering-construction industry.

Advertising pages, laid out to capitalize the illustrative opportunities afforded by the new size and the rotogravure process, will have an attention value beyond that approachable in any other monthly publication. Size, format and rotogravure have been combined to produce an effect that is attractive and impressive.

The new *Construction Methods* offers a timely and welcome medium through which to support 1933 sales objectives with dominant advertising at low cost.

CONSTRUCTION METHODS

330 West 42nd Street • New York City

8,000 c.p. for 12 hours

with the

National Carbide X-100

V-G LIGHT

or 16,000 c.p. for 6 hours with use of extension

National Carbide V-G Light X 100

on one 7-lb. charge of National 14-ND carbide and 7 gallons of water. One man easily handles this V-G Light. Nothing to get out of order. Weight 75% on bottom. If knocked over, there is no danger and light continues operating when righted. Weight only 33 lbs. empty; 96 lbs. full. Has been specified on recent Westchester County Sanitary Sewer Commission jobs. All V-G Lights mean

Portable Daylight—Without Waste

No waste of carbide, whether used intermittently or continuously. They have proved their safety, economy and efficiency.

Write for Booklet "Lights" on complete line of V-G Lights, V-G Handy Light and V-G Lantern. A Light or Lantern for every purpose.

Send for Illustrated Booklet "Lights"

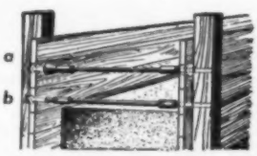
NATIONAL CARBIDE SALES CORP.

Lincoln Bldg., New York

V-G, Handy Light—Y199

National Carbide Lantern WLI-CI

Specify National Carbide in the Red Drum — Coast to Coast Distribution.



MARION Hex Coupling —a better form tie

On each end of threaded rod of proper length, spin a Marion Hex Coupling. Pass through the form from each side a lug bolt or short threaded rod and screw it into the coupling as at "b" above.

For better adjustment slip a Marion Spreader over the threaded end of the bolt before it enters the coupling, as at "a" above.

Result—a form tie of ample strength. With it, centering may be drawn together into accurate alignment. Simple—no skilled labor—in fact little labor of any kind.

112 pages of useful information

25¢

The Marion Contractors' Handbook is off the press! It has 60 pages of useful tables, 17 pages of miscellaneous data, 35 pages of detailed formwork drawings, including forms for

Beams • Columns • Copings Drop Panels • Floors • Footings • Girders • Joists • Silos • Slabs • Spandrels Stairs • Tanks • Towers • Walls • Windows.

It shows how to build forms for repeated use, how to clamp them, the best way to use wire ties, how to build hoist towers, how to figure material quantities for concrete for different purposes, what various materials weigh—a mass of useful data—112 pages and only nine pages devoted to Marion Contractors' Specialties.

The regular price of the book is $1.00. We'll send you a copy for 25c

Marion Malleable Iron Works • 923 Miller Avenue • Marion, Indiana

(105)

Your name stamped on this book FREE

At no additional cost to you, we will stamp your name or a friend's name, in gold, on the front cover of every copy of O'Rourke's General Engineering Handbook ordered from this advertisement. This is a special Christmas offer, limited to acceptance before January 1, 1933.

***Essential data in ALL fields of engineering*—Now made handy in ONE compact volume!**

Here is a book with a new idea — one handbook of 900 pages of practical, up-to-date information, useful reference data, specific facts, definite methods, essential formulas in:

—civil engineering
—mechanical engineering
—electrical engineering
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The most frequently needed and essential engineering information in the form in which you want it and can use it—one handy book —clear, concise, complete, convenient.

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"I find this publication more adapted to desk use than any other handbook, as statements of problems are concise and it is not necessary to wade through elementary matter."
GEORGE W. PERRY,
Constructing Engineer, Philadelphia Gas Works Co.

"I find O'Rourke's General Engineering Handbook gives me quite fully the information I wish in engineering problems."
—CHARLES H. GEARHART,
Architect.

"I am very much pleased with the new handbook and would not care to be without it as it gives much desired information in the one volume."
—DONALD E. YOUNG,
Civil Engineer, U. S. Engineers—C. of E.

Do you want to make a friend a gift combining personal thoughtfulness with real utility? Do you want a copy of **O'Rourke's General Engineering Handbook** that you will doubly prize? Then take advantage of this free stamping offer. Send the coupon today. (Proper remittance should be enclosed with orders and, of course, stamped copies are not returnable.)

SPECIAL HOLIDAY OFFER COUPON

McGraw-Hill Book Company, Inc., 330 West 42d St., New York.

Send me **O'Rourke's General Engineering Handbook**, with name stamped in gold on the front cover. I enclose $4.00 and understand that stamped books are not returnable. (This offer expires Jan. 1, 1933.)

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(Name to be stamped. Please print.)

Name .....

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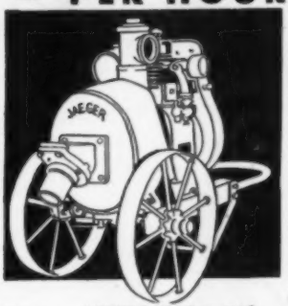
20,000 GALLONS PER HOUR

JAEGER 3" SELF-PRIME CENTRIFUGAL



100% automatic priming at lifts over 25 feet, heads up to 60 feet, 5 h. p. gas or electric power, weight only 400 lbs., Timken equipped. One of a complete line. Get our lower prices.

The JAEGER MACHINE Co.
800 Dublin Avenue Columbus, Ohio

MIXERS 3½ S to 84S.
HOISTS to 50 h. p.
PLACING EQUIPMENT.

JAEGER 10S - HANDLES LIKE A 7S

Fastest, easiest to handle 2 bagger, all-steel short coupled, with knuckle steering, roller bearing wheels. Water Regulator meets all state requirements

GET OUR LOW PRICES

Tilting, non-tilting Mixers, Contractors Pumps, Placing Equipment. Send for catalog.

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Fulton Quality

TARPAULINS WINDBREAKS & TENTS

The FULTON LINE of Tarpaulins, Windbreaks, Tents, Burlap, Roll Duck, etc., is produced by mass-production and cost-saving methods, which assure high quality at reasonable prices. These products afford complete protection for your property and workmen against cold and wet weather. They help you speed up work, reduce costs and make profits for you. Write today for samples and prices.

Fulton Bag & Cotton Mills
Manufacturers Since 1870
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Ebonite XL

is superior in every particular on our LORAIN "75"

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CONTRACTORS' EQUIPMENT

OFFICE: 1001 SOUTH LAMAR STREET

TELEPHONE 2-1000

DYNAMITE
BLASTING POWDER
BLASTING SUPPLIES

GOLD MEDAL EXPLOSIVES

Dallas, Texas,

National Welding & Grinding Co.,
2825 Williams Street,
Dallas, Texas

Gentlemen:

With reference to the piece of 3½ x ⅜" Ebonite Brake Lining which you furnished us some time ago to be tested out in connection with various brake linings which we have been using, would say that we turned this lining over to one of our best shovel operators and it was put on a Lorain "75" shovel which was loading caliche in the vicinity of Lubbock, Texas.

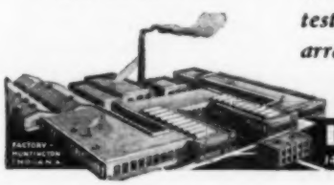
This operator used this lining for thirty days and reported to us that in every particular, Ebonite is superior to any lining he ever used before. In fact it eliminated the grabbing of the clutches and the shovel also operated much more easily with this Ebonite Lining than with former linings on this machine or any he had ever used.

The wearing qualities of this lining, he also stated was much longer than any other lining used. In fact, this operator recommended Ebonite very highly. We trust that this will be pleasant news to you and will aid you in getting this fine lining distributed around your territory.

Yours truly,
F. C. CRANE COMPANY
Signed: F. C. Crane

EBONITE X L Brake Lining and Blocks stand up under conditions fatal to ordinary linings. Because they contain far more minerals (heat conductors) and far less asbestos (heat insulator) they dissipate surface heat that with other linings would cause slippage or crystallization and drum scoring. Ebonite is made by a patented process that combines the best features of all types of lining. It is woven (tensile strength), molded (uniformity), compressed and baked (hardness and wearing quality). Impregnated from within, Ebonite holds its braking quality until worn to wafer thinness.

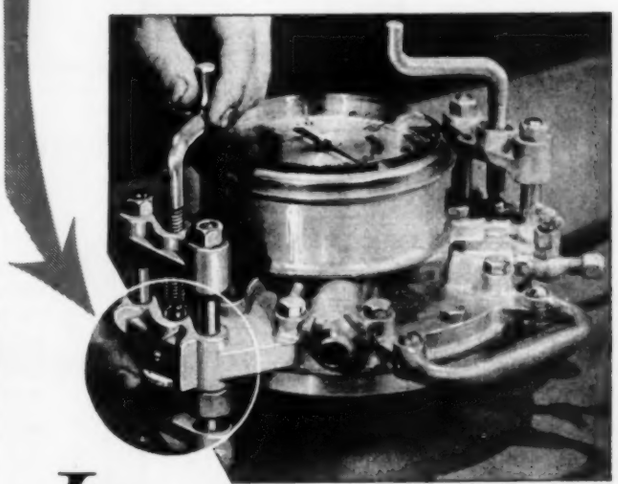
Write for details of our free test offer. Your supplier can arrange it.



L. J. MILEY COMPANY
INCORPORATED
1462 S. Michigan Avenue, Chicago, U.S.A.

ANNOUNCING the IMPROVED MARTIN-DECKER TENSION INDICATOR

Now every wire and cable load can be measured quickly, conveniently and with absolute assurance of UNIFORM ACCURACY.



JUST a simple device—the new disc style Feeler Gauge encircled above. But it gives Martin-Decker Tension Indicators "split hair" accuracy. It even eliminates the possibility of incorrect readings through faulty application.

Martin-Decker Tension Indicators are paying their way in the service of the U. S. government and many of America's most prominent engineering, utility and industrial corporations. They are making it easy to detect uneven stresses and overloads—and thus doing away with the danger and delay of cable breaks. Their use makes longer spans possible and practical.

Send for the complete story. Learn what Martin-Decker Tension Indicators can do for you. Mail your name and address at once.

Name .....

Address .....

.....

THE WEIGHT INDICATOR

MARTIN-DECKER CORPORATION

3431 CHERRY AVENUE — LONG BEACH, CALIF., U. S. A.

ANNOUNCEMENT

HIGHWAY AND BUILDING EXPOSITION-ROAD SHOW and ANNUAL CONVENTION

THESE are important events of the Highway and Building Congress which should draw everyone connected with highway and building construction to Detroit for the week of January 16, 1933.

The Exposition-Road Show and Congress will provide the greatest opportunity for co-ordinated effort by every individual and organization in allied construction activities to assure the advancement of all highway and building interests. *You* should be there!

Never before has construction been confronted by problems which demanded the universal co-operation of everyone for successful solution. The convention program of the American Road Builders' Association will feature subjects of direct interest to every highway official, contractor and engineer. At the Convention and Congress sessions national leaders will discuss such vital subjects as:—

(a) Justification of continued highway construction.
(b) The place of highways in national transportation.
(c) Why gasoline taxes should be used strictly for highways and streets.
(d) The future programs for highway development by the Federal Government, states, counties and municipalities.

The Exposition-Road Show must be seen if you are to utilize the latest development in equipment and materials to secure improvements and savings in the construction, maintenance and operation of highways and buildings. At no time have methods and equipment been so far advanced for increasing the economy and efficiency of construction operations.

Decide now to be there — with members of 21 national organizations attending the Congress as well as their own Annual Conventions and Special Meetings.

Lowest Railroad fares in convention history (round trip, 1-1/9 one-way fare) . . . special reduced hotel rates . . . smoker, ball, and banquet held jointly by all participating organizations . . . these economies should clinch your decision today to pack your grip and join us.

For hotel reservations and further details address:

AMERICAN ROAD BUILDERS ASSN.
Suite 938 National Press Building
WASHINGTON, D. C.

Highway and Building Congress

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Participating Organizations

American Institute of Steel Construction
American Road Builders' Association
American Society of Municipal Engineers
American Welding Society
Asphalt Institute
Associated Equipment Distributors
Associated General Contractors of America
Construction League of the United States
Highway Research Board
International Association of Public Works Officials
Materials Handling Institute with Materials Handling Division of American Society of Mechanical Engineers
National Association of Builders Exchanges
National County Roads Planning Commission
National Crushed Stone Association
National Paving Brick Association
National Ready Mixed Concrete Association
National Rural Letter Carriers Association
National Sand and Gravel Association
Portland Cement Association
Steel Founders' Society of America, Inc.
Truck Association Executives of America

Sponsoring Organizations

American Institute of Consulting Engineers, Inc.
American Motorists Association
American Petroleum Institute
Common Brick Manufacturers Association of America
Canadian Good Roads Association
National Highways Association
National Lime Association
National Lumber Manufacturers Association
Producers' Council
Wire Reinforcement Institute

SEARCHLIGHT SECTION

EMPLOYMENT : BUSINESS : OPPORTUNITIES : EQUIPMENT—USED or RESALE

UNDISPLAYED—RATE PER WORD
Positions Wanted, 5 cents a word, minimum $1.00 an insertion, payable in advance. *(See ¶ on Box Numbers.)*
Positions Vacant and all other classifications 10 cents a word, minimum charge $2.00.
Proposals, 50 cents a line an insertion.

INFORMATION:
Box Numbers in care of New York, Chicago and San Francisco offices count 10 words additional in undisplayed ads.
Discount of 10% if one payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

DISPLAYED—RATE PER INCH:
1 inch.....$6.00
2 to 3 inches..... 5.75 an inch
4 to 7 inches..... 5.50 an inch
Other spaces and contract rates on request.
An advertising inch is measured vertically on one column, 3 columns—30 inches—to a page.

COPY FOR NEW ADVERTISEMENTS RECEIVED UNTIL 10 A. M. THE 27TH OF THE MONTH FOR THE ISSUE OUT THE FOLLOWING MONTH C.M.

WEMLINGER

STEEL SHEET PILING
SOLD — RENTED — BOUGHT
"A NATION WIDE SERVICE"

NEW YORK 500 Fifth Ave. | CHICAGO 228 No. La Salle St. | PHILADELPHIA 1015 Chestnut St. | BOSTON 31 State St. | RICHMOND 1708-1722 Lewis St. | TAMPA 315 Tampa St. | NEW ORLEANS 1105 Maritime Bldg. | HOUSTON 117 Eastwood St. | LOS ANGELES 2044 Santa Fe Ave.

STEEL PILING
NEW and USED
MOST ECONOMICAL SECTIONS ROLLED.
STOCKS AT PRINCIPAL POINTS THROUGHOUT THE COUNTRY FOR PROMPT SHIPMENT.

BOUGHT — SOLD — RENTED — RE-PURCHASED
1 Length or 10,000 Every Length Guaranteed

L. B. FOSTER CO.
NEW YORK • PITTSBURGH • CHICAGO

AGENTS WANTED

EARN from $1 to $5 an hour extra without interfering with your present employment. Whether office man, salesman, technical man, foreman or worker you can make ready cash quickly and easily each week showing our lists of business and technical books to fellow employees and others. You recommend them, we do the rest. No experience required. Complete equipment free. Write T. Crawford, Dept. C.M., McGraw-Hill Book Co., 330 W. 42d St., N. Y. C.

SALESMAN WANTED

WANTED: Equipment salesman. Preferably man with background of management of his own company. Large volume of construction plant equipment used on an extensive project to be sold. In reply, state complete qualification, including photograph and salary desired, as position will be filled immediately. Location East. In reply address SW-105, Construction Methods, 330 West 42d St., New York City.

Large Surplus Plant
Send for list or call on us for anything in heavy construction.
MASON & HANGER COMPANY, INC.
Engineers-Contractors
500 Fifth Ave., New York

Practical facts on every phase of building construction

The Dingman books have won a wide reputation among builders and building contractors for their sound, practical and easy-to-understand discussion of building construction work. All of the material has been drawn from actual practice.

This library is intended for

[1] The building contractor who wants a handy reference set that will give him almost instantly a ready answer to most of the problems that come up in the course of the day's work.

[2] The young men in the building industry who intend to make the business of construction their life work, and who want the kind of guidance that will aid them to climb to the top.

[3] Everyone in the building industry who wants to keep his job by increasing his usefulness and efficiency.

Free Examination—Small monthly payments
Without a cent of expense—without any obligation on your part—you may examine the Dingman Building Contractors' Library for 10 days and determine its value for yourself. Try the books out on your everyday test send them back at our expense. If the books prove satisfactory and you decide to keep them, pay only $1.50 in ten days and then $2.00 a problems—make them prove their worth to you. Unless they meet every month for six months.

HERE is a Library of books that are packed to the covers with the best plans and methods for speeding up production, saving materials and labor, and cutting costs. These six books cover every phase of practical construction work from estimating building costs to the selling of construction service—from plan reading and quantity surveying to practical job management. With the aid of these books the contractor can get business in these dull times by learning how to make savings, and through them being able to make lower bids. The construction superintendent can learn how to keep costs down, which insures his job these days.

The Dingman Building Contractors' Library

Each one of the volumes in this set is a complete handbook on some important subject. Sturdily bound and pocket size, it will go right "on the job" with you for immediate consultation.

Practical data is given on analyzing a construction job into its component parts—estimating the costs of labor, haulage, equipment, materials, etc.—plan reading and determining quantities from specifications—personnel management—successful supervision of every building operation—efficient and economical business methods—office procedure such as accounting banking, purchasing, etc.—advertising and selling methods for contracting service—and a complete data book of tables, forms and calculations most frequently used by the builder.

McGRAW-HILL
FREE EXAMINATION COUPON

McGraw-Hill Book Co., Inc., 330 West 42d Street, New York, N. Y.
You may send me for 10 days' free examination, the new six-volume Dingman BUILDING CONTRACTORS' LIBRARY. I agree either to return the books at the end of 10 days or send a first payment of $1.50 then and $2.00 a a month for six months.

Signed .....
Address .....
City and State.....
Official Position .....
Name of Company.....
(To insure prompt shipment, write plainly and fill in all lines.) F.C.M. 12-32

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this name on your torches means you have THE BEST

the difference lies in the burner

No other safety light can give you so dependable and economical protection . . . yet real TOLEDO TORCHES cost no more than the rest.

• • •

Your dealer can supply you.

USE THE TOLEDO TORCH NO OTHER SIGNAL MEANS SAFETY

The Toledo Pressed Steel Co.
TOLEDO OHIO

Save with Steel

The ANNUAL
ROAD BUILDERS NUMBER
will be published
JANUARY, 1933

The new Construction Methods, which will be printed by the rotogravure process, with enlarged page size—will be distributed at the Highway and Building Congress—Detroit, January 16-20—as the Annual Road Builders Number.

This is without a doubt, one of the best advertising "buys" of any monthly magazine serving the engineering-construction industry.

The closing dates for advertising copy will be slightly advanced because of the new rotogravure process. Accurate layout, glossy photographs or drawings and copy should reach us as early as possible. First forms close December 22nd.

Get aboard from the start.

CONSTRUCTION METHODS

(see page 38)

PUNCHING PILING DOWN

The Warrington-Vulcan in use at the Salonika Plain Reclamation Project in Greece by the Foundation Co., New York.

Real punching action accurately describes the way the Warrington-Vulcan Pile Hammer applies the driving energy to piling.

There is no wasted energy. The Warrington-Vulcan punching action gets the very maximum of penetration at each blow. The work is, therefore, speeded. Driving costs per pile are lowered.

This correct punching action is due to the Warrington-Vulcan principle embodied only in these pile hammers,—"a low velocity blow from a heavy mass of ram." Long satisfactory service is assured when you own a Warrington-Vulcan Pile Hammer. After years and years in service, not one has ever completely worn out.

VULCAN IRON WORKS
327 No. Irving Avenue, CHICAGO, ILLINOIS

Southern Representatives:
Woodward, Wight & Co., Ltd., 451 Howard Avenue, New Orleans, La.
Representatives for California, Nevada and Japan:
Harron, Rickard & McCone Co., 1600 Bryant St., San Francisco, Calif.
Representative for the States of Washington and Oregon:
A. H. Cox & Co., Inc., 1757 First Avenue, S., Seattle, Wash.

Warrington-Vulcan

WM S TWINING
AMBLER
PENNSYLVANIA
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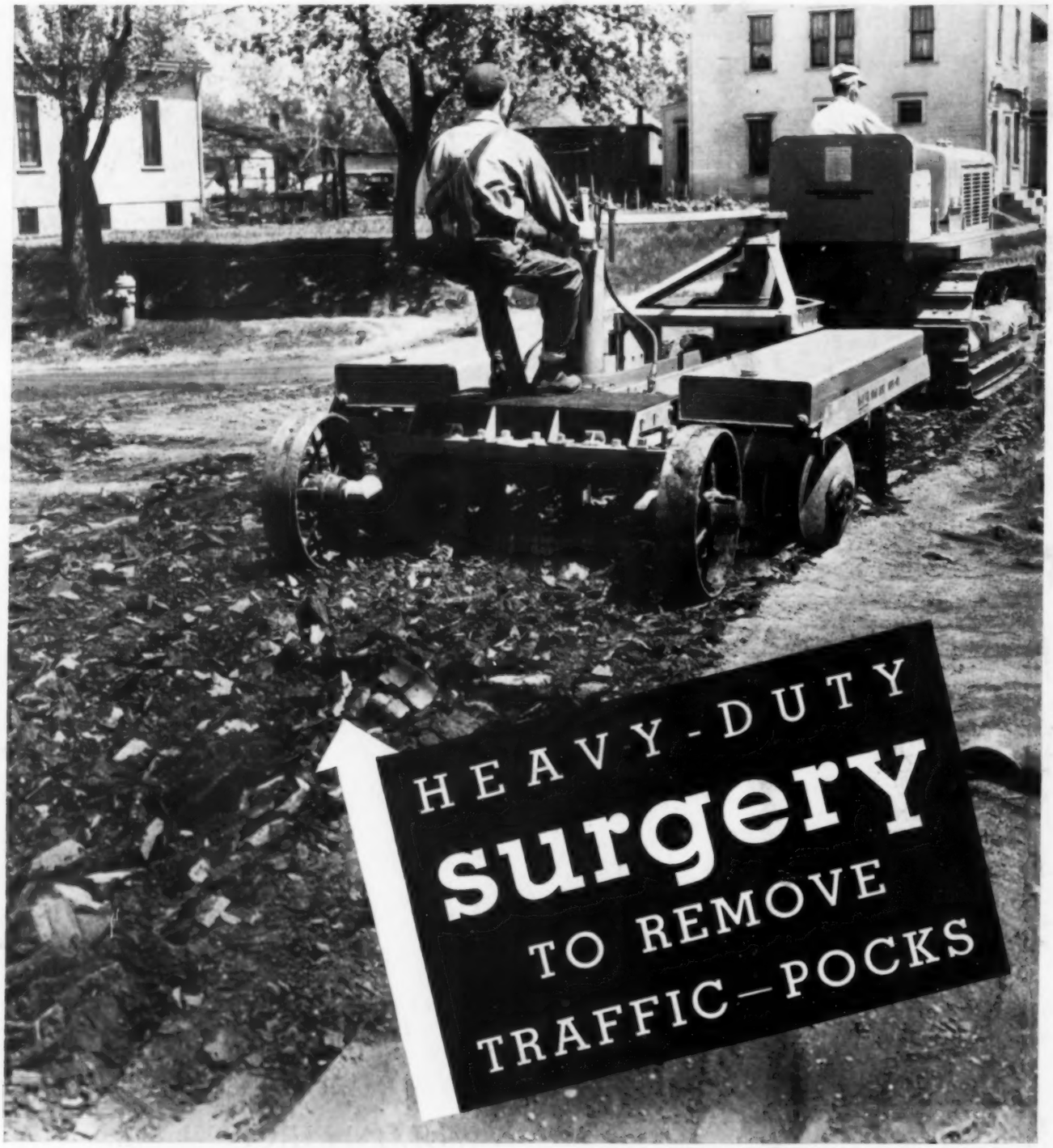

EVEN with the big blades of this 3-ton Baker road disker biting clear through the tough, hard macadam —the rugged "Caterpillar" Thirty-Five Tractor is handling the load at second speed.

The pits and ruts of traffic scars are removed—the surface is economically put in condition to be renovated or replaced . . . the husky "Caterpillar" Tractor —with its eager power and year-round traction—keeps on adding to the impressive list of jobs it does better, quicker, cheaper!

Caterpillar Tractor Co., Peoria, Ill., U.S.A.
Track-type Tractors Road Machinery
Combines
(There's a "Caterpillar" Dealer Near You)

Prices—f. o. b. Peoria, Illinois

FIFTEEN . . .	$1100	THIRTY-FIVE	$2400
TWENTY . . .	$1450	FIFTY	$3675
TWENTY-FIVE	$1900	SIXTY-FIVE .	$3850
DIESEL . . .	$6500		

CATERPILLAR

REG. U. S. PAT. OFF.

TRACTOR